RADIOLOGY

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Psoriatic Arthritis: A Roentgenologic Study[1]

ROGELIO AVILA, M.D., DAVID G. PUGH, M.D., CHARLES H. SLOCUMB, M.D., and R. K. WINKELMANN, M.D.

THE CONCEPT that psoriatic arthritis is a distinct clinical entity has been endorsed by many, questioned by some, and rejected by others. A considerable number of authors are of the opinion that changes in the joints of patients with psoriasis are indistinguishable from those of rheumatoid arthritis and that unusual cases are atypical forms of the latter disease. On the other hand, psoriatic arthritis has been distinguished clinically from ordinary rheumatoid arthritis in many respects, particularly in the involvement of the distal interphalangeal joints together with concurrent activity of arthritis and psoriasis of the nails and skin, and the usually good response to therapy in early cases.

It has long been known that arthritis and psoriasis are frequently associated. Dawson and Tyson found that in 300 non-arthritic patients the incidence of psoriasis was 0.7 per cent while in 1,000 with rheumatoid arthritis it was 2.6 per cent. Gribble found psoriasis in 1 per cent of the general population and in 4.2 per cent of patients with rheumatoid arthritis. From these and similar studies, it has been concluded by some that psoriasis has a heightened incidence in rheumatoid arthritis and that the arthritis of psoriatic patients is of the rheumatoid variety or closely resembles it. The purpose of this study was to determine whether the arthritis occurring in association with psoriasis is truly rheumatoid arthritis or whether the two can be distinguished.

Because the joints are simple structures with only limited patterns of response, the early manifestations of various forms of arthritis may look alike clinically and roentgenologically. The articular cartilage may be damaged, narrowing the joint space. The synovial membrane may be thickened, and the margins of subchondral bone eroded, without any distinguishing change being present. Until the joint has become severely affected, one may not be able to distinguish different forms of arthritis. The characteristic manifestations of psoriatic arthritis are seen most clearly in far-advanced cases and these can be easily separated from cases of rheumatoid arthritis.

In 231 of 7,280 cases of arthritis encountered at the Mayo Clinic from 1949 through 1953, an associated diagnosis of psoriasis was made. Roentgenograms of the hands, feet, and other joints were available in 175 of these. The records of the 175 patients were reviewed in detail, and the films were studied and classified ac-

[1] From the Mayo Clinic and Mayo Foundation, Rochester, Minn. (R. A., Fellow in Radiology, Mayo Foundation; D. G. P., Section of Roentgenology; C. H. S., Section of Medicine; R. K. W., Section of Dermatology). The Mayo Foundation is a part of the Graduate School of the University of Minnesota. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.

Abridgment of thesis submitted by Dr. Avila to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Radiology.

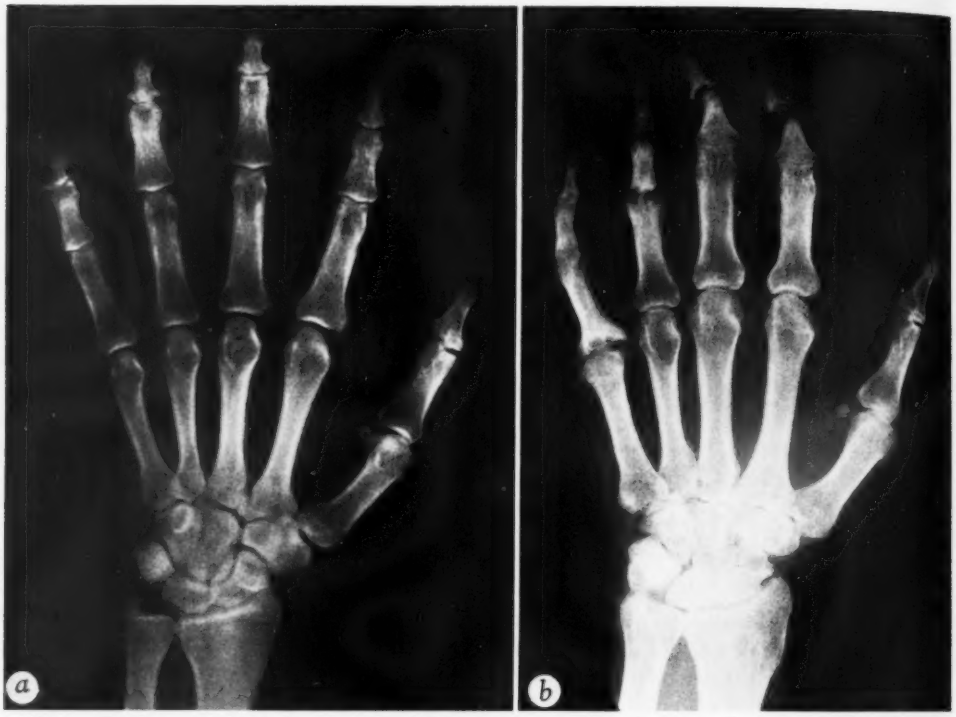

Fig. 1. Psoriatic arthritis in 2 cases. *a.* Rheumatoid type of involvement affecting only the distal interphalangeal joints of the fingers.
b. Bony ankylosis in some interphalangeal joints while in others destruction has caused widening of the joint spaces and subluxation of the distal phalanges. Despite severe articular changes, there is no osteoporosis.

cording to the predominance of certain changes in the hands and feet and large joints, including the sacroiliac joints. In 20 cases in which there were clinical signs of arthritis, there was no roentgen evidence of the disease, or evidence only of osteoarthritis. These cases, therefore, were not considered further. This left 155 cases for this study. A control group of 100 cases of rheumatoid arthritis without psoriasis was also studied, and the arthritic changes seen roentgenologically were compared with those in the psoriatic cases. In many of the control series rheumatoid arthritis was severe, and in all definite destructive arthritic changes had occurred.

FIVE ROENTGENOLOGIC SIGNS OF PSORIATIC ARTHRITIS

A review of our material revealed five roentgenologic signs that were of great importance for the recognition of psoriatic arthritis. Some of these had been noted by other authors, and some had not had previous recognition. They are as follows:

1. Destructive arthritis involving predominantly the distal interphalangeal joints of the fingers and the interphalangeal joints of the toes.
2. Bony ankylosis of interphalangeal joints of hands and feet.
3. Destruction of interphalangeal joints of hands and feet, with abnormally wide joint spaces and sharply demarcated adjacent bony surfaces.
4. Destruction of the interphalangeal joint of great toe with bony proliferation at base of distal phalanx.
5. Resorption of tufts of distal phalanges of hands and feet.

1. *Changes Resembling Rheumatoid Arthritis but Involving Entirely or Predominantly the Distal Interphalangeal Joints*

Fig. 2. Psoriatic arthritis. *a*. Of right hand ten years after onset of joint symptoms. The articular surfaces of the distal interphalangeal joints are destroyed and the spaces widened.

b. Same hand two years later. Bony ankylosis of the distal interphalangeal joints of the fifth and fourth digits.

c. Left hand of the same patient thirteen years after the onset of joint symptoms. Destruction of the articular surfaces of the distal interphalangeal joints with widened, clear-cut spaces and subluxation of some terminal phalanges.

d. Same hand one year later. Bony ankylosis of the distal interphalangeal joint of the index finger which previously presented a destroyed, widened space.

Fig. 3. Psoriatic involvement of the toes. *a*. Anteroposterior view. Destructive process involving the distal interphalangeal joints. Only the terminal joint of the great toe is well visualized; the others are obscured by superimposition of the phalanges. Note absorption of the tuft of the great toe.
b. Oblique projection. Destruction of the distal interphalangeal joint spaces causing them to be widened, with the adjacent bone showing sharp demarcation despite the fact that the articular surfaces have been destroyed. The oblique view is valuable in demonstrating these changes, which are not evident in the anteroposterior view.

of the Hands and the Interphalangeal Joints of the Feet: The joint spaces are narrowed, and there is erosion of the margins of the subchondral bone (Fig. 1, *a*). This feature of psoriatic arthritis has long been known and has been reported by many authors (1, 2, 5, 7, 8, 15). Rheumatoid arthritis in the hands involves predominantly the proximal interphalangeal, metacarpophalangeal, and carpal joints; almost never does it affect the distal interphalangeal joints without extensive antecedent involvement of many of the other joints just mentioned In psoriatic arthritis, all of the distal interphalangeal joints may be affected, but not infrequently only one or two will be involved. In the feet roentgenologic evidence of rheumatoid arthritis is usually seen in the metatarsophalangeal joints, and involvement of the interphalangeal joints is infrequently encountered, whereas in psoriatic arthritis the interphalangeal joints are characteristically affected.

2. *Bony Ankylosis of the Interphalangeal Joints of the Hands and Feet:* Ankylosis of the interphalangeal joints of the hands and feet occurs frequently in psoriatic arthritis (Figs. 1, *b* and 2). In rheumatoid arthritis it is often present in the carpal and tarsal joints but is rare in the interphalangeal joints, although fibrous ankylosis of these joints is common. These differences have been noted in the literature but have not received sufficient emphasis (16, 18).

3. *Destruction of Interphalangeal Joints of Hands and Feet With Abnormally Wide Joint Spaces and Sharply Demarcated Ad-*

jacent Bony Surfaces: In far-advanced psoriatic arthritis a distinctive destructive arthritis of the hands and feet frequently is present. This is characterized by widened interphalangeal joint spaces with the ends of adjacent bones sharply demarcated despite the fact that the bony cortices of the joints have been destroyed (Figs. 1, *b* and 2). This finding has not been emphasized previously in the literature but is of the utmost diagnostic importance when present, since it has not been observed in rheumatoid arthritis. It does not, in fact, appear to occur in any other type of arthritis except that which is seen in association with that rare condition, reticulohistiocytoma (14). For practical purposes, therefore, this type of articular destruction can be considered pathognomonic for psoriatic arthritis. It is readily seen in the interphalangeal joints of the fingers but often is not recognized in the toes unless oblique views are taken (Fig. 3, *a* and *b*). Occasionally in rheumatoid arthritis contracture of a joint with subluxation widens the joint, but in psoriatic arthritis, although subluxation does occur, the widening is not attributable to that cause.

4. *Destruction of the Interphalangeal Joint of the Great Toe With Bony Proliferation at Base of Distal Phalanx:* In psoriatic arthritis a combination of destruction and significant bony proliferation in the interphalangeal joint of the great toe often occurs (Fig. 4). This also has failed to be adequately emphasized in the literature. The destruction of the joint may not be great, but often it is extensive and is similar to that described in the preceding paragraph. An interesting feature is the associated distinctive proliferative growth of bone at the base of the distal phalanx of the toe. Changes involving the interphalangeal joint of the great toe occur occasionally in rheumatoid arthritis and these may resemble somewhat those seen in psoriatic arthritis but this is rare. When these changes are accompanied by resorption of the tuft of the toe, the diagnosis of psoriatic arthritis can be made with assurance (Fig. 5,*a*).

Fig. 4. Psoriatic arthritis showing the proliferative bony reaction at the base of the distal phalanx of the great toe. There is predominant involvement of the distal interphalangeal joints, resorption of the tufts, and absence of osteoporosis despite the severe changes. In this projection the margins of the distal interphalangeal joints are obscured by superimposition of the phalanges.

5. *Resorption of the Tufts of the Distal Phalanges of the Hands and Feet:* Resorption of the tufts of the distal phalanges of both hands and feet has been described in the literature as occurring in psoriatic arthritis (1, 4, 9) (Figs. 3, *a* and 5, *a*). In its characteristic form it has been observed only in psoriatic arthritis, the changes differing greatly from those seen in acrosclerosis. This feature, seen most frequently in the toes, is of considerable diagnostic value.

The destructive changes, with widened joint spaces, described above will often proceed to a stage in which there is such a degree of destruction that so-called pencil-pointing and cupping of the tubular bones of the hands and feet are present (4, 7, 9, 15–17) (Fig. 5, *b*). When these changes become extreme, they sometimes cannot

TABLE I: PSORIATIC ARTHRITIS IN 155 CASES

Group	Roentgenologic Signs of:	Cases	Involvement of Interphalangeal Joints of Fingers and Toes: Destructive Arthritis of Distal Joints	Bony Ankylosis	Widening of Spaces with Adjacent Bony Surfaces Sharply Demarcated	Destruction of Interphalangeal Joint of Great Toe with Bony Proliferation at Base of Distal Phalanx	Resorption of Tufts of Distal Phalanges
1	Psoriatic arthritis only	48 (31%)	48 (100%)	12 (25%)	17 (35%)	16 (33%)	12 (25%)
2	Psoriatic plus typical rheumatoid arthritis	30 (19%)	30 (100%)	13 (43%)	13 (43%)	8 (27%)	8 (27%)
3	Rheumatoid arthritis plus one sign of psoriatic arthritis	18 (12%)	13 (72%)	3 (17%)	0	1 (6%)	1 (6%)
4	Rheumatoid arthritis only	59 (38%)	7 (12%)	0	0	0	0
Control	Rheumatoid arthritis without psoriasis	100	11 (11%)	1	0	2 (2%)	0

be distinguished from those that occur in far-advanced rheumatoid arthritis or secondary to soft-tissue infection of the feet (11). When serial roentgenograms are studied, the destruction of the bone incident to pencil-pointing and cupping can be seen to have developed as a far-advanced manifestation of the process which earlier consists in widening of the joint spaces with the ends of the adjacent bones sharply demarcated. Thus, though the ultimate appearance may not be pathognomonic, the successive stages in its development point to a diagnosis of psoriatic arthritis. When pencil-pointing and cupping occur in psoriatic arthritis, there are almost always typical diagnostic changes in the great toe.

ACCESSORY ROENTGENOLOGIC SIGNS

Accessory signs suggesting psoriatic arthritis were seen also. For instance, one frequently noted absence of osteoporosis despite severe arthritic changes (Figs. 1, *b*, 2, and 6). This has been mentioned in the literature (3, 12, 13, 15) and can perhaps be explained by the intermittent character of the arthritic process. Between acute or subacute exacerbations, patients with psoriatic arthritis often have almost complete remission and are entirely relieved of pain. It may be for that reason that there often is no disuse atrophy and, therefore, no osteoporosis. Absence of osteoporosis in cases of arthritis does not, of course, of itself warrant a diagnosis of psoriasis; it must be associated with others of the five signs that have been given.

Another striking accessory sign of psoriatic arthritis is the lack of ulnar deviation of the fingers. Since this is frequently seen in far-advanced cases of rheumatoid arthritis, its absence in psoriatic arthritis seems significant.

CLASSIFICATION OF CASES

On the basis of the five roentgenologic signs described above, as indicative of psoriatic arthritis, and the presence of roentgenologic signs of other types of arthritis, our 155 cases were divided into four groups. The findings in these four groups and in the control group are given in Table I.

Group 1 consisted of 48 cases in which changes in the joints were limited to those described as the five signs of psoriatic arthritis. In all of these cases the characteristic destructive changes occurred in the distal interphalangeal joints, and in none was there any rheumatoid type of involvement of other joints. In approximately 25 per cent of the group bony ankylosis was apparent in interphalangeal joints of the hands. Destructive arthritis of interphalangeal joints with widened joint spaces was even more frequent (35 per cent), and the changes that have been described as occurring in the great toe were noted in 33 per cent of the cases.

Fig. 5. Psoriatic arthritis in 2 cases. *a*. Left foot showing characteristic changes in the interphalangeal joint of the great toe and absorption of the tufts. Widened interphalangeal joints of the toes were seen in the oblique view and resembled those shown in Fig. 3, *b*.

b. Involvement of the right foot in another case with pointing of the heads of the metatarsal bones and bony ankylosis of the proximal interphalangeal joints. The destruction of the interphalangeal joint of the great toe is a type characteristically seen in psoriatic arthritis.

Resorption of the tufts of the distal phalanges was present in 25 per cent.

Group 2 numbered 30 cases in which, in general, the condition resembled rheumatoid arthritis in some joints, though in each instance several of the signs of psoriatic arthritis were present. As a matter of fact, the changes that have been described as characteristic of psoriatic arthritis were encountered more frequently in this group than in Group 1. In all of the cases the distal interphalangeal joints of the hands were involved. Bony ankylosis of interphalangeal joints and destructive arthritis with widened joint spaces occurred in the same frequency (43 per cent). The higher incidence of these changes represents the more advanced stage of the disease in Group 2. The typical changes in the great toe were less frequent than in Group 1 but still occurred in a little more than a fourth of the cases. Resorption of the tufts of the distal phalanges was slightly more frequent in this group.

In *Group 3*, numbering 18 cases, the disease in a general way looked like rheumatoid arthritis, but in each case one of the signs of psoriatic arthritis was found. Almost three-fourths of the patients had involvement of the distal interphalangeal joints of the hands. Seventeen per cent had bony ankylosis of the interphalangeal joints. None showed destruction of the joints with widened joint spaces, but this is entirely within keeping, since that type of destruction is present only in far-advanced cases and it is obvious that in this group the disease was not advanced. The roentgenograms of 1 patient showed the typical changes in the great toe, and of another, resorption of the tufts.

Group 4 consisted of 59 cases that looked like rheumatoid arthritis roentgenologically and that exhibited none of the signs of psoriatic arthritis. In 7 of these cases the distal interphalangeal joints were involved but involvement of other joints of the hands was suggestive of rheumatoid arthritis. No instance of bony ankylosis of interphalangeal joints, destruction of the interphalangeal joints with widened joint

Fig. 6 Psoriatic arthritis with bony ankylosis of interphalangeal joints, especially of the distal joints. The destructive changes in the wrist and in the metacarpophalangeal joints resemble those of rheumatoid arthritis.

spaces, typical bony change in the great toe, or resorption of tufts was found. It is probable that this group represented typical rheumatoid arthritis, since it is to be expected that this disease would be at least as common in patients with psoriasis as in the general population. These patients should be studied again in five or ten years to see what percentage continues to show only signs of rheumatoid arthritis and what percentage progresses to show signs of psoriatic arthritis. In this way it may be possible to determine whether the incidence of rheumatoid arthritis is actually increased among patients with psoriasis.

The *control group*, as mentioned before, consisted of 100 patients with rheumatoid arthritis without psoriasis. Those with involvement of the distal interphalangeal joints had antecedent involvement of other joints of the hands or feet. Bony ankylosis of one interphalangeal joint was seen in 1 patient. Extensive destruction of the joint with widened joint space and sharp demarcation of the adjacent bones was not observed in any patient although many had far-advanced rheumatoid arthritis. Destructive changes in the interphalangeal joint of the great toe in 2 patients somewhat resembled that change seen in psoriatic arthritis. Neither of these, however, nor any of the other patients with rheumatoid arthritis, showed absorption of the tufts.

FURTHER OBSERVATIONS

Absence of Osteoporosis: All five groups of patients were studied for osteoporosis, as its absence has been considered an accessory sign of psoriatic arthritis. It was most infrequent in Group 1, with an incidence of only 27 per cent. In these cases the arthritic changes were most severe, at least so far as the advanced changes of psoriatic arthritis were concerned. In Groups 2, 3, and 4 osteoporosis was a frequent finding, but the relatively small number of cases in which observations were made makes any statistical data unreliable. It seemed, however, that in these groups osteoporosis was almost as frequent as in the control group, consisting of cases of rheumatoid arthritis without psoriasis.

Absence of Ulnar Deviation: Absence of ulnar deviation of the fingers was a striking feature in the cases of psoriatic arthritis. While no accurate statistical data can be given, the fingers were deviated much more frequently in the control cases, that is, in the cases of rheumatoid arthritis without psoriasis, than in the cases of psoriasis with arthritis. It was our impression that ulnar deviation of any degree was apparent in only about 9 per cent of the cases of Group 1, as compared with about 55 per cent of the control series.

Involvement of Joints Other Than the Interphalangeal, Metacarpophalangeal, and

Fig. 7. An unusual case of psoriasis with arthritis. There are widespread bony ankylosis and destruction of interphalangeal joints. The whole picture is suggestive of rheumatoid arthritis. However, the arthritis developed with psoriasis and became active when the psoriasis was active. The extensive bony ankylosis of interphalangeal joints would rarely occur in rheumatoid arthritis. *a*. Right hand. *b*. Left foot. *c*. Right knee.

Metatarsophalangeal Joints: Involvement of joints other than the interphalangeal, metacarpophalangeal, and metatarsophalangeal was of particular interest in Groups 2 and 4. In 29 of the 30 cases in Group 2 there was roentgenographic evidence of arthritis of the large joints. These patients had arthritic changes in the hands or feet, with signs of psoriatic arthritis, but the involvement of other joints, such as the carpal and tarsal joints, elbow, shoulder, and knees had the appearance of rheumatoid arthritis (Fig. 6). In 17 (59 per cent) of the 29 there was a definite parallelism in the exacerbations and remissions of the lesions in the skin or nails and joint symptoms. In Group 4, 51 of the 59 patients had roentgenographic changes in the large joints that looked like rheumatoid arthritis. Thirteen (22 per cent) of the 59 patients showed parallelism of symptoms in the skin or nails and in the joints.

Of particular interest is the case of a 38-year-old woman whose psoriasis started in the scalp in 1929 and progressed to involve the elbows and nails. Four years after onset of the psoriasis, coincident with an exacerbation of the skin symptoms, arthritis became evident in the feet, knees, hands, and elbows. Progression of the arthritis was rapid and in five years there were deformities of the extremities. At the time of examination at the Mayo Clinic, sixteen years after onset of the arthritis, bony ankylosis was evident in many joints, including some of the distal and proximal interphalangeal joints of the hands and interphalangeal joints of the feet (Figs. 7, *a* and *b*). The large joints were greatly affected and the roentgenologic appearance was that of rheumatoid arthritis (Fig. 7, *c*). There was coincidence in the exacerbations and remissions of the skin and joint symptoms, with the large joints participating.

Associated Spondylitis: The roentgenograms in 14 cases of arthritis with psoriasis showed evidence of spondylitis that could not be differentiated from that seen in rheumatoid spondylitis. In all 14 cases the destructive changes were in the sacroiliac joints, and in some there was ligamentous calcification in the spinal column. In 4 instances, concurrent exacerbations and remissions of psoriasis and low back pain had occurred. All these patients were males, and all had pronounced arthritic

changes in the hands or feet, or both, that presented several of the signs of psoriatic arthritis. In 1 man with involvement of the sacroiliac joints, the peripheral joints showed some of the signs of psoriatic arthritis, but there was no parallelism in the skin and joint symptoms. In the other 9 patients, the changes in the hands and feet did not display any of the signs of psoriatic arthritis, and were indistinguishable from rheumatoid arthritis.

RELATIONSHIP OF ONSET OF PSORIASIS AND ARTHRITIS

To determine the relationship of the onset of psoriasis and arthritis, the records in all 175 cases were reviewed. This included the 155 cases in which roentgenologic evidence of arthritis was found and the 20 cases in which clinical evidence only was present. In 9 cases the onset of skin and joint symptoms could not be determined. In 150 cases psoriasis preceded the onset of arthritis by a period varying from one month to forty-six years. In 62 (41 per cent) of the 150 cases arthritic symptoms began within the first five years after the psoriasis developed. In 16 patients arthritis was present before psoriasis was recognized, the period of antecedence varying from six months to twenty-five years. Of these 16 patients, 2 had arthritis that fulfilled the roentgenologic criteria of psoriatic arthritis; 4 had characteristics of psoriatic arthritis plus those of rheumatoid arthritis; 4 had arthritis that resembled rheumatoid arthritis with only one sign of psoriatic arthritis; 6 had arthritis that looked only like rheumatoid arthritis.

Association of Exacerbations and Remissions in Skin and Joints: The 155 cases in which there was roentgenologic evidence of arthritis were studied, and the association or lack of association of the arthritic and psoriatic manifestations was observed. The data do not warrant statistical analysis, since in many cases no mention was made of the association of the two conditions. Briefly it can be said that exacerbation and remission of the arthritis and psoriasis were most often parallel in the patients in Group 1, but it was impressive that, in many of the cases in which the roentgen findings were those of rheumatoid arthritis only, this association was also frequent.

Psoriatic Involvement of the Nails: The nail changes sought for were the lateral onycholysis, subungual keratosis, and stippling that are characteristic of psoriasis. No attempt was made to correlate the arthritis of the fingers and toes with involvement of the nail in the corresponding digit, since data on this point were not available.

In Group 1, all but 1 patient (98 per cent) had diseased nails at the time of examination. In the single exception there was typical psoriasis affecting the skin. The same situation prevailed in Group 2; 29 of the 30 patients (97 per cent) had involvement of the nails. In Groups 3 and 4 involvement of the nails occurred in 67 per cent and 61 per cent, respectively. Thus it seemed evident that psoriatic arthritis is almost always accompanied by nail changes, and that rheumatoid arthritis with psoriasis may show these findings.

Rheumatoid Arthritis in Psoriasis: Of greatest interest is the finding that a distinctive form of destructive arthritis is associated with psoriasis, but in a large number of cases (Groups 2 and 3) what appeared to be a combination of psoriatic and rheumatoid arthritis occurred. At present it is not possible to say whether this is truly a combination of the two types of disease, or whether it represents rheumatoid arthritis that has been modified by psoriasis or psoriatic arthritis that shows unusual features which are indistinguishable from the rheumatoid type. It seems likely that most of the patients in Group 4 had rheumatoid arthritis that developed concurrently with psoriasis, but there is a possibility that, as the arthritis progresses, the psoriatic arthritis of some

of these may become typical or the mixed manifestations of both psoriatic and rheumatoid arthritis may develop, as in Groups 2 and 3.

SUMMARY

One hundred fifty-five cases of psoriasis with arthritis and 100 cases of rheumatoid arthritis without psoriasis were studied and the roentgenologic characteristics of the arthritic changes were compared.

Five signs are suggested as the roentgenologic criteria for the diagnosis of psoriatic arthritis.

In the 100 cases of rheumatoid arthritis without psoriasis, most of these signs never occurred and in only 3 cases were there any changes that resembled psoriatic arthritis. Even these were minimal, consisting of bony ankylosis of one interphalangeal joint in 1 case and changes in the interphalangeal joint of the great toes like those seen in psoriatic arthritis in 2 cases.

From this study, it appears that psoriasis is often accompanied by a characteristic form of arthritis which can be recognized roentgenologically. In 48 (31 per cent) of 155 cases the condition could be classified as psoriatic arthritis. In an equal number of cases (31 per cent) some of the articular manifestations of psoriatic arthritis plus those of typical rheumatoid arthritis were seen. The roentgenologic manifestations in 59 of the 155 (38 per cent) were those of rheumatoid arthritis only. It seems evident, therefore, that while psoriatic arthritis is a destructive arthritis typical of psoriasis, rheumatoid arthritis also is frequently associated with that disease.

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SUMMARIO IN INTERLINGUA

Arthritis Psoriatic: Un Studio Roentgenologic

Cento cinquanta-cinque casos de psoriasis con arthritis e 100 casos de arthritis rheumatoide sin psoriasis esseva studiate, e le characteristicas roentgenologic del alterationes arthritic in le duo gruppos esseva comparate.

Es proponite cinque signos como criterios roentgenologic in le diagnose de arthritis psoriatic: (1) Arthritis destructive, afficiente predominantemente le articulationes interphalangee distal del digitos de mano e le articulationes interphalangee del di-

gitos de pede; (2) ankylosis ossee del articulationes interphalangee de mano e pede; (3) destruction del articulationes interphalangee de mano e pede, con anormalmente large spatios articular e nettemente demarcate superficies del ossos adjacente; (4) destruction del articulation interphalangee del halluce, con proliferation ossee al base del phalange distal; (5) resorption de villos del phalanges distal in mano e pede.

In le 100 casos de arthritis rheumatoide sin psoriasis, le majoritate de ille signos nunquam se manifestava, e alterationes simile a illos de arthritis psoriatic esseva presente in solmente 3 del 100. E mesmo in iste 3, ille alterationes esseva minime, consistente de ankylosis ossee de un articulation interphalangee in 1 caso e de alterationes del articulation interphalangee del halluce del typo del alterationes vidite in arthritis psoriatic in 2 casos.

Ab iste studio il pare que psoriasis es frequentemente accompaniate de un forma characteristic de arthritis que pote esser recognoscite roentgenographicamente. In 48 del 155 casos (31 pro cento), le condition poteva esser classificate como arthritis psoriatic. In un numero equal de casos (31 pro cento), certes del manifestationes de arthritis psoriatic esseva vidite in association con le manifestationes typic de arthritis rheumatoide. In 59 del 155 casos (38 pro cento) le manifestationes roentgenologic esseva exclusivemente illos de arthritis rheumatoide. Assi il pare evidente que, ben que arthritis psoriatic es un arthritis destructive typic de psoriasis, arthritis rheumatoide es etiam frequentemente associate con ille morbo.

The Gastric Cardia and Fundus

Extrinsic and Benign Tissues Simulating Gastric Cancer[1]

EDWIN L. LAME, M.D.

THE GASTRIC cardia is well known for its importance in harboring carcinoma and for the common difficulty of its clear roentgen delineation. Variations and benign influences may closely resemble the more dangerous lesion.

The collection of cases presented here comprises only that material which is rare in our experience or quite new to us. An attempt has been made not to display obvious or common lesions or effects. Some of this has been shown to consultants of great experience, so that the commonplace would be eliminated and the unusual might be identified by broader knowledge. These discussions have been most valuable, although some of the apparently normal variants deserve yet further recording and confirmation.

The normal organ relations are shown in Figure 1: the right lobe of the liver, the left lobe, the small rectangular caudate lobe that at some time we suspected might cause the defect to be shown later, the gastrohepatic omentum attaching to the lesser curve of the stomach, and the spleen.

For comparison, 4 carcinomas are shown in Figure 2. These resemble: Figure 2, A, some splenic defects we have seen; B, the 2 cases of normal variants shown in Figure 10; C, the liver cyst shown in Figure 3, B; and D, the spleen shown in Figure 4, A.

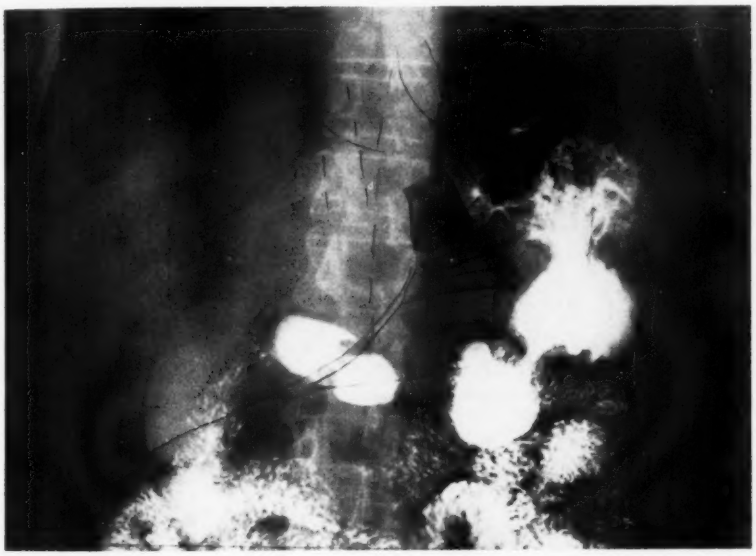


Fig. 1. Normal relation of organs about the gastric cardia and fundus. The caudate lobe of the liver is represented by the dark rectangular area; the gastrohepatic omentum by the sweeping linear shading.

1. The Liver (Fig. 3): In Figure 3, A, a case of advanced cirrhosis with marked liver enlargement displacing and constricting the cardia is shown; Figure 3, B demonstrates a large benign cyst of the liver creating an irregular defect by adhesion, duplicating that due to the car-

[1] From the Presbyterian Hospital, Philadelphia, Penna. Submitted for publication in August 1959.

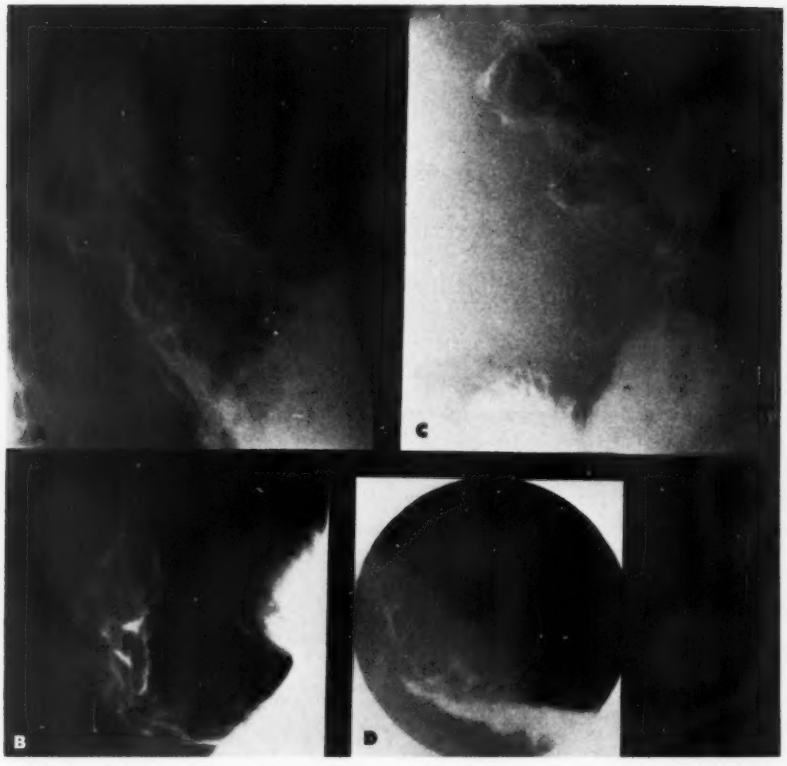


Fig. 2. Four carcinomas of the cardia and fundus. A. Simulation of a spleen impression. B. Imitation of the mucosal prominence or prolapse at the esophageal entry (Fig. 10). C. Duplicate of a liver cyst (Fig. 3, B). D. Appearance similar to roentgenogram of a spleen defect (Fig. 4, A).

cinoma of Figure 2, C so far as we could determine; Figure 3, C shows a far advanced neuroblastoma of the liver in a child, again displacing the cardia and causing fixation.

2. The Spleen: Since the normal spleen rarely creates a pressure defect on the stomach, enlargement is nearly always a prerequisite for displacement and deformity of the cardia. Such changes occur for the most part in cases of blood dyscrasia in our experience. Diagnosis is usually not too difficult, but we have been wrong in two or three instances. Figure 4, A shows a large lymphomatous spleen creating pinching of the cardia. The appearance is much like that of the cancer in Figure 2, D. Figure 4, B is a carcinomatous splenomegaly.

3. The Heart: Our first indication that the enlarged heart was a factor in differentiation came at fluoroscopy. The left ventricle normally rests upon the left side of the diaphragm, and immediately below is the cardiac-fundal portion of the stomach. One of the important aids in estimating the size of the left ventricle without an opaque medium is to observe its pulsation against the air bubble in the stomach while the patient is erect. Figure 5, A demonstrates the moderate impression of a slightly large left ventricle. Such small defects may be more difficult to evaluate than larger ones like those shown in Figures 5, B 1 and 2 and Figure 6. Fluoroscopy is important in studying the slight changes.

4. The Aorta: Defects due to a tortuous aorta are not common, since it seems

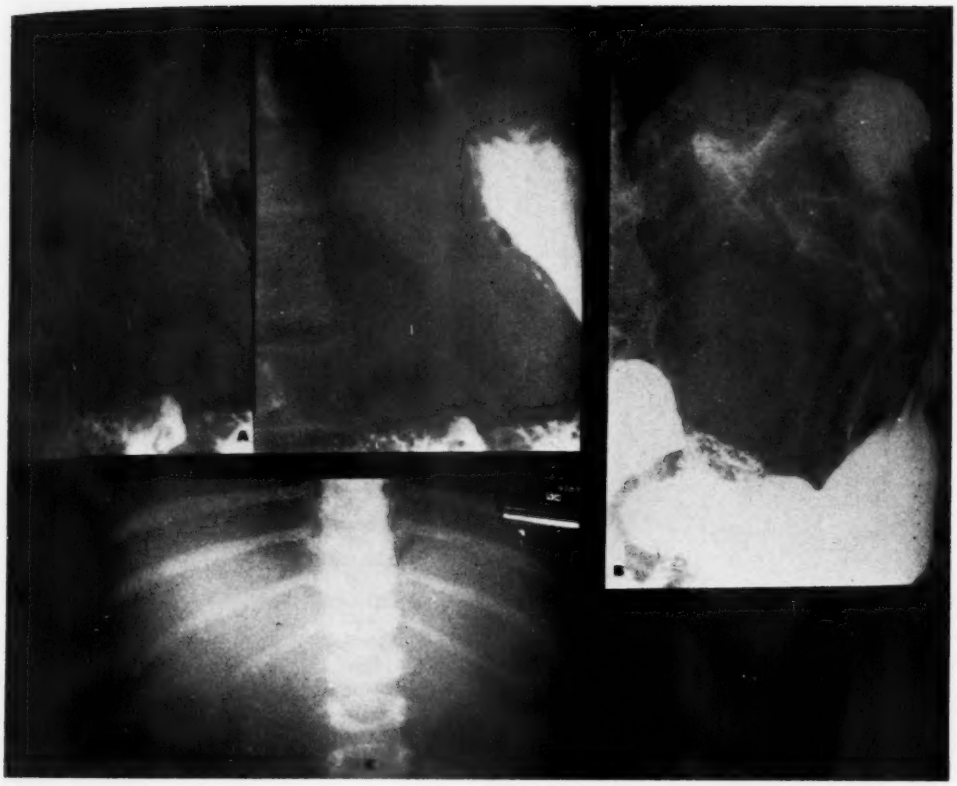


Fig. 3. Enlarged livers deforming the stomach. A. Advanced cirrhosis and enlargement. B. Large adherent liver cyst. C. Large neuroblastoma depressing the cardia.

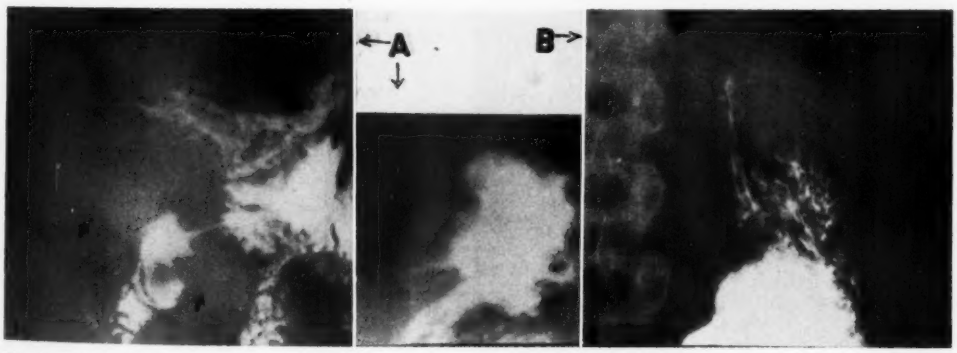


Fig. 4. Enlarged spleens. A. Lymphoma creating pressure on the medial superior aspect. B. Carcinomatous spleen depressing and narrowing the fundus.

that the aortic foramen through the diaphragm, neighboring the cardia, confines even the degenerated vessel remarkably well, and the large bends and aneurysms are found above in the thoracic and below in the abdominal region. An exception is shown in Figure 7, A 1 and 2 where the aorta is seen bulging to the left and ante-

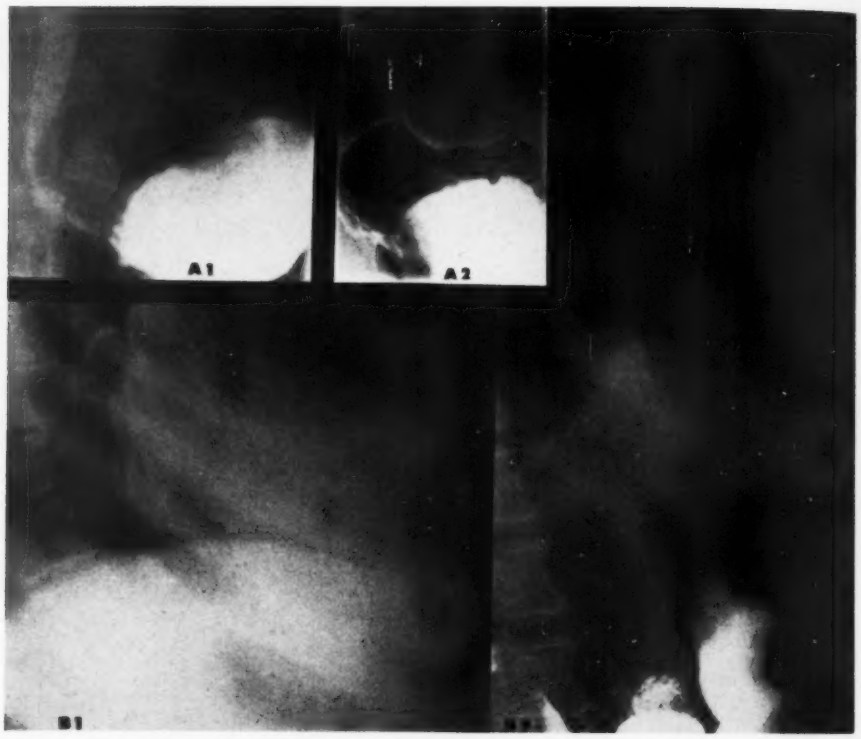


Fig. 5. The left ventricle of the heart. A. Small defect. B. Larger depression and flattening of the fundus.

Fig. 6. Enormous left ventricle flattening the fundus.

riorly as it emerges from the diaphragm. Its tortuous thoracic portion may be seen above the diaphragm. A second instance, Figure 7, B, is the largest abdominal aneurysm yet encountered by us. Its superior border rose to the lesser curve of the cardia and deformed it, imitating tumor of the liver or stomach.

5. Circular Muscle Fibers of the Stomach: A convex filling defect on the superior part of the lesser curvature, 4 examples of which are shown in Figure 8, has been the object of some anxiety and study. It has imitated intrinsic tumor of the stomach, liver nodule, lymph node, and aorta. It is found uncommonly and usually only when the stomach is rotated for inspection of the posterior lesser curvature. There is no relation to a cascade stomach in our experience. In 1 case the defect nearly disappeared in the inspiratory phase and often it straightens in the erect posture when the

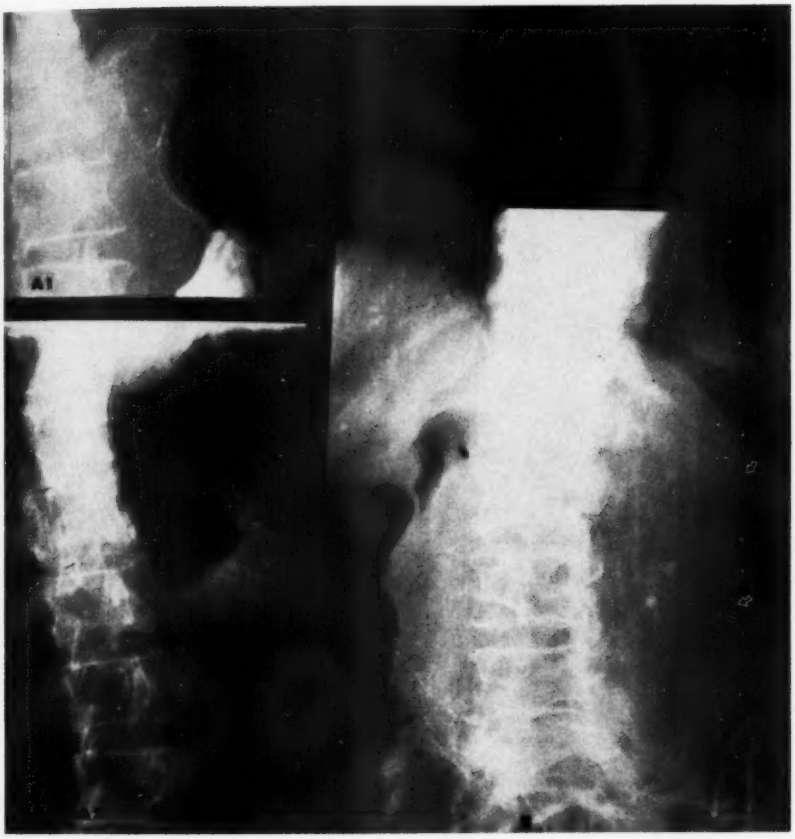


Fig. 7. The aorta. A. Tortuous sclerotic vessel impinging on the cardia. B. Huge abdominal aneurysm arising from below and deforming the cardia.

stomach is full. In most instances it may be differentiated from tumor by its changeable nature, but in 2 of our cases exploration was required. No abnormality was disclosed.

Much time has been spent at the operating and autopsy tables seeking an answer to this problem. The caudate lobe of the liver normally lies closely adjacent to the curvature but it is rarely enlarged, it has not been implicated in the patients explored, and the defect behaves other than one due to pressure by that lobe. The gastrohepatic ligament (omentum) was suspected at one stage in our study. Changing or unusual tension in this ligament, however, appears a most improbable cause. Para-aortic nodes do not reach this area of the stomach, unless tremendously enlarged. There has been no sign of node disease in any of these patients and none has had an ulcer, tumor, or other organic lesion of the superior part of the stomach. With elimination of the aforesaid conditions as probable factors, we felt that this defect might be due to a normal variant or some benign change in stomach structure. We showed our material to Dr. Oscar Batson (1), who has demonstrated in corroded specimens the rich network of vessels of the left gastric group and the circular and oblique muscles of the stomach. He suggested that either sclerosis or large size of *vessels* or variation in the *circular muscles* might be causes.

Although the number of cases is far too

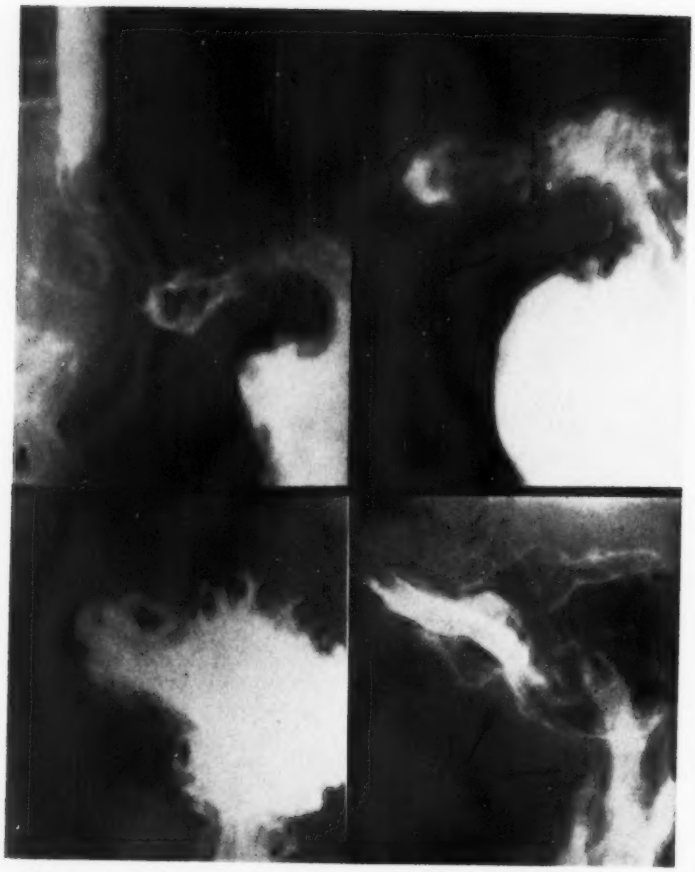
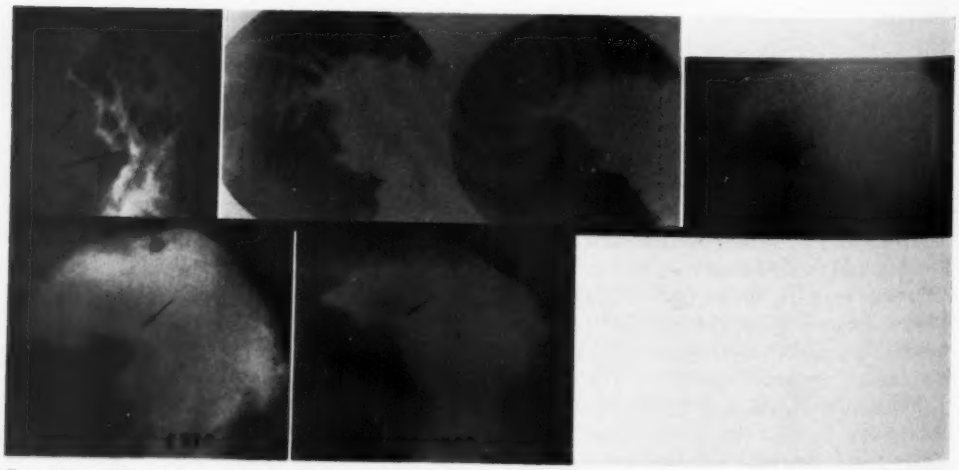


Fig. 8. A and B. Defects in 2 cases probably due to circular stomach muscles of unusual density and tension. A. Autopsy findings in this case were normal. B. No exploration was undertaken in this patient.



C and D. Two other cases of normal variation, probably due to circular muscles. C. Operative findings in this case were normal. D. This patient was not explored.

small for evaluation of the incidence of hypertension, the idea is interesting in that high blood pressure was present in 3 of our cases (Figs. 8, A, B, and D). The defect occurs at the point where the left gastric vessels are large and branching. Large normal or congested and sclerotic vessels might create such a notch.

Batson's thought of circular muscle variation (diagrammed by Forssell, 3) seems an even more probable explanation (Fig. 9). The stomach is highly variable in form and the imprint of circular muscle is often seen by the radiologist at the pyloric portion. Unusually heavy or tense circular bands near the cardia, where the anatomists know the vascular and muscular structure to be dense, seems the most substantial cause for the notch in the superior lesser curve.

Hodges (4) has observed this notch and, in answer to our query, describes it as a flexion of the stomach. The case he has shown us is a strikingly good example and, as we have also observed, the defect decreases markedly on distention of the stomach and in the erect posture. Inspiration may also straighten it. Hodges' case is, in our opinion, an excellent example of what should be a circular muscle defect.

Schatzki (6) has seen this notch and interprets it as the medial edge of the spleen or some other external tissue. From our examinations at autopsy and surgical exploration, we cannot agree to that interpretation. Certainly many fluoroscopists have seen the notch and regarded it for what it usually is—a normal variant amenable to clear interpretation. But, sometimes, it is a real problem and may be solved only by surgical inspection.

6. Mucosal Prolapse of Cardia: Two patients have shown an esophagogastric junction that forced surgical exploration since we could not feel certain on radiologic grounds. In each case, a flat fold of soft tissue only a few millimeters thick appeared at the inner aspect of the cardia (Fig. 10). With distention by carbon dioxide and assumption of the erect posture this was reduced or abolished. These

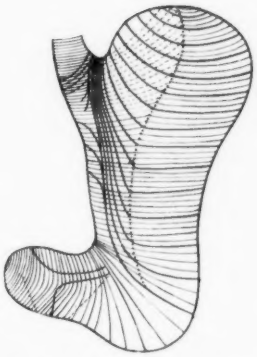


Fig. 9. Diagram of circular and oblique muscles of the stomach (after Forssell, 3).

features were still insufficient, however, to allow dismissal of the cases. At open stomach exploration, done thoroughly by competent surgeons, no abnormality was found. Perhaps some excess fat tissue lay on the peritoneal surface, but this we consider unimportant.

Similar observations have been made by us at the ileocecal valve when excess soft tissue could not be certainly diagnosed as benign. The present cases resemble these ileocecal cases more closely than anything else in our experience. Until further evidence denies the assumption, we shall call it mucosal prolapse. Pendergrass (5) and Finkelstein (2) have gone over this material with us and, although they do not recall any examples in their own experience, they support our interpretation.

7. Metastatic Nodes: Although lymph-node metastases are common in the paraaortic chain, they are rarely demonstrated radiographically at the level of the cardia. One instance has occurred in this group, a 1.5-cm. node metastasis from adenocarcinoma of the uterus (Fig. 11). The upper picture demonstrates the pleural metastasis and the lower the small notch on the cardia below the diaphragm.

SUMMARY

The gastric cardia is well known for its importance in harboring carcinoma. Variations and benign influences may closely resemble this dangerous lesion. Some more

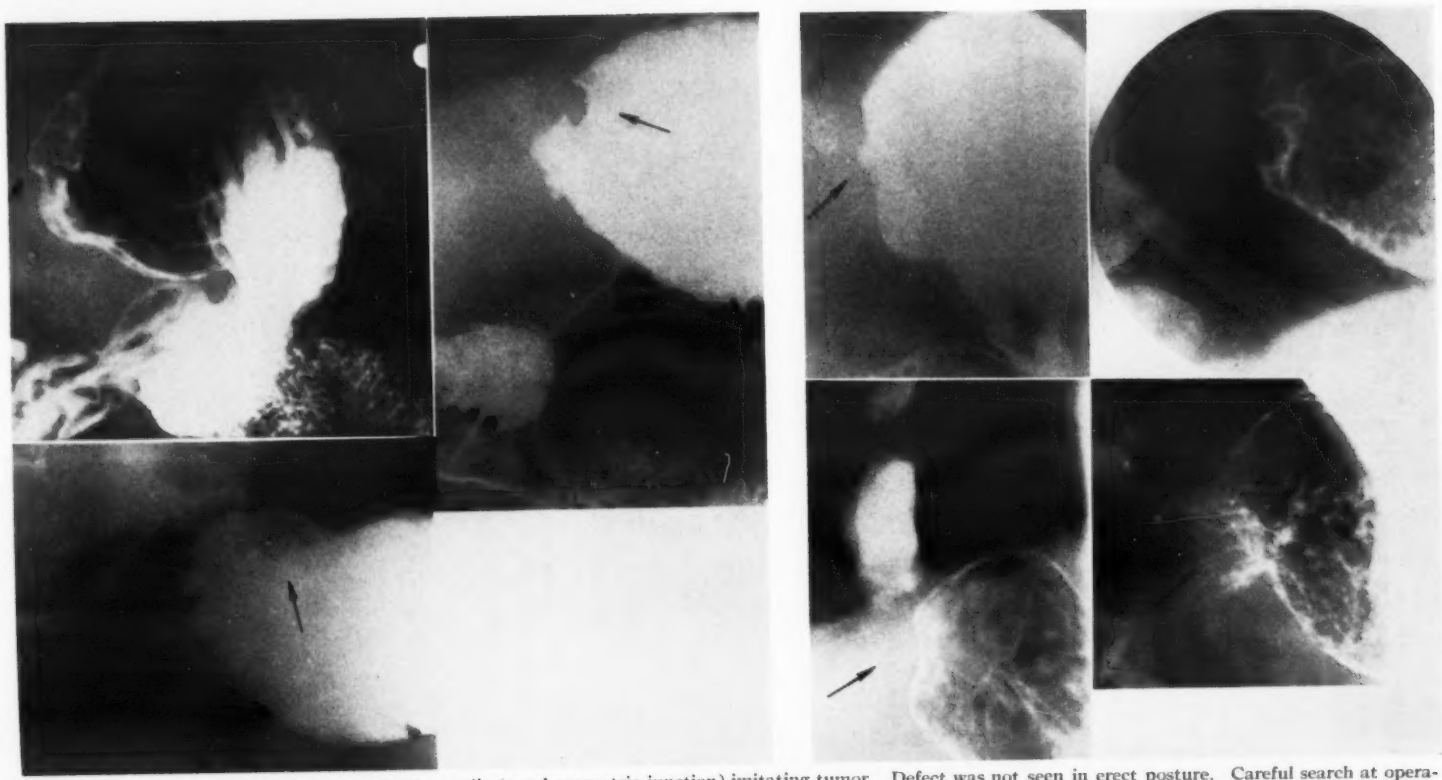


Fig. 10. Two cases of prominent mucosa at the cardia (esophagogastric junction) imitating tumor. Defect was not seen in erect posture. Careful search at operation disclosed only fat externally at the cardia, nothing abnormal inside. Probable cause: prolapse of esophageal mucosa.

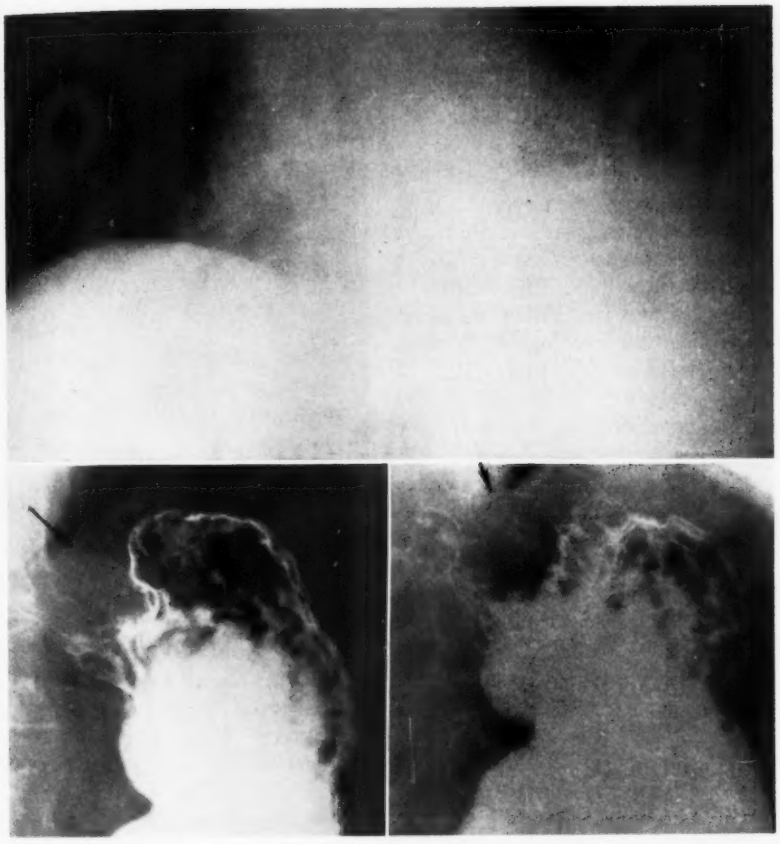


Fig. 11. Metastatic cancer in subdiaphragmatic lymph node from carcinoma of the endometrium. The appearance is similar to Fig. 10.

rarely encountered examples are described here. An explanation of the appearances may be found in the liver, spleen, heart, aorta, metastatic nodes, or variants of the stomach itself.

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SUMMARIO IN INTERLINGUA

Cardia e Fundo Gastric—Tissus Extrinsec e Benigne que Simula Cancere del Stomacho

Le cardia gastric es ben cognoscite pro su importantia como albergator de carcinoma e pro le difficultate de su delineation. Variationes e influentias benigne pote resimilar intimemente le plus perículose cancere. Es describite alicun rarmente incontrate exemplos. Le explication del apparentias pote esser trovate in hepate, splen, corde, aorta, nodos metastatic, o variantes del stomacho mesme.

Peptic Ulcer Associated with Corticosteroid Therapy: Serial Roentgenographic Studies[1]

JAMES G. BULGRIN, M.D., EDMUND L. DUBOIS, M.D., and GEORGE JACOBSON, M.D.

DURING A period of two and one-half years, 77 patients who were candidates for or were receiving steroid therapy, were observed for peptic ulcer. Most of them were examined roentgenologically at three-month intervals. This made it possible to correlate ulcer incidence with dose, duration of therapy, and effect of individual drugs, as well as to add to the very sparse information upon the behavior of ulcers during continuous steroid administration. Almost all of the patients had systemic lupus erythematosus and required large amounts of steroids. The incidence of peptic ulcer in this treated group was compared with the incidence in a similar group of patients not receiving these hormones. Since there are relatively few reports of roentgenologic surveys of patients treated with steroids, and none with such extensive serial studies while on high dosage, it was thought that presentation of our findings and comparison with previous data would be of interest.

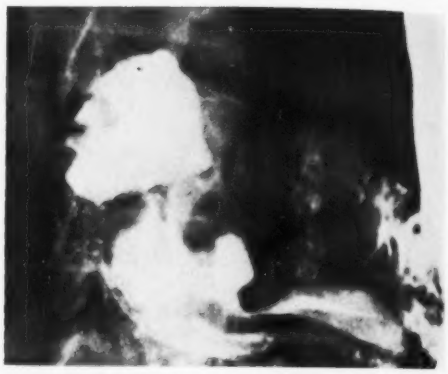

Fig. 1. Patient E. M. Large lesser curvature antral ulcer indicated by arrow.

Up to 1954, Sandweiss (1) and Wollaeger (2) were able to collect from the literature only 50 to 55 instances of peptic ulcer occurring during steroid therapy. Since then the incidence has been variously reported as 0 to 31 per cent. When cortisone alone was available, several reports indicated an incidence of less than 7.8 per cent (3–7). With the use of prednisone, although a few investigators (8, 9) found complicating peptic ulcer in less than 5 per cent, the figures of others ranged from 12.5 to 31.0 per cent (10–18). Among the latter, Kern, Clark, and Lukens (12) and Kammerer *et al.* (17, 18) showed a rather clear-cut increase in ulcer incidence with increasing steroid dosage. The data of Kammerer and his associates are especially striking, both as to total ulcer incidence and dosage correlation. They report an overall incidence of 31 per cent. When 10 mg. of prednisone or its equivalent was given, there was an almost tenfold increase in ulcer incidence over that following lower doses. All of their patients had received steroids for six months or more, and a single roentgenologic study was made of each patient. Prolongation of therapy beyond six months did not affect ulcer incidence. Gedda and Moritz (16) found an increased risk of peptic ulcer with increasing length of treatment. Others failed to make such a correlation.

Since we employed roentgen methods of diagnosis, we were particularly interested in studies using similar diagnostic criteria. Bollet, Black, and Bunim (10), Evans (15), Gedda and Moritz (16), and Kammerer *et al.* (17, 18) reported the occurrence of ulcer in 16 to 31 per cent of their series, and these authors in each instance remarked upon the frequency with which the patients were asymptomatic or had symptoms atypical for ulcer in the face

[1] From the Departments of Internal Medicine (E.L.D.) and Radiology (J.G.B. and G.J.), University of Southern California School of Medicine, and the Los Angeles County Hospital, Los Angeles, Calif. Accepted for publication in April 1960.

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TABLE I: COMPARATIVE THERAPY IN ULCER AND NON-ULCER PATIENTS
Results of Roentgenologic Studies Correlated with Drug, Dosage, and Duration of Observation

TABLE 1: COMPARATIVE THERAPY IN ULCER AND NON-ULCER PATIENTS
Results of Roentgenologic Studies Correlated with Drug, Dosage, and Duration of Observation

Steroid	No. of Patients Receiving Drug	Median Duration Steroid Therapy to Last X-ray Examination (months)	Total Patient Months X-ray Observation	Patients with Ulcer				Patients with No Ulcer Shown			
				No. of Patients	Dose Range 4–8 Weeks Prior to Demonstration Active Ulcer (mg./day)	Median Dose (mg./day)	Average Period X-ray Observation (months)	No. of Patients	Dose Range During X-ray Observation (mg./day)	Median Dose (mg./day)	Average Period X-ray Observation (months)
Prednisone and Prednisolone	27	10	98	5 (18.5%)	12.5–100	40	4.8	22	10–50	30	3.2
Methylprednisolone	18	12.5	94	4 (22%)	36–144	60	3.7	14	8–48	20	5.6
Triamcinolone	23	21.5	169	4 (17.4%)	12–96	40	13.7	18	8–100	28	6.3
Dexamethasone	17	8	45	2*	3.5–18	10.7	6.5	13	0.5–8.0	3	2.2
TOTAL	85†		408	15				67			

* Period of study much too short for conclusions.
† A number of patients received more than one steroid.

of an objectively demonstrated lesion. The only radiologic survey showing an extremely low incidence of ulcer is that of Meltzer *et al.* (9). There was no obvious variation in dose, duration of treatment, or individual drug to explain this.

MATERIALS AND METHODS

Seventy-seven patients from the Collagen Disease Clinic of the Los Angeles County General Hospital were studied. Sixty-three of them received steroid therapy. All but 2 were ambulatory outpatients. Eighty-one per cent were female. Except in 3 cases of rheumatoid arthritis and 4 of other collagen diseases, the diagnosis was systemic lupus erythematosus. An attempt was made to examine all patients roentgenologically prior to instituting steroid therapy but, since many were on such treatment when the study was begun and others required therapy immediately, this was achieved in only 41. Once steroid administration had started, serial roentgen examinations were done at intervals of approximately three months. The program was carried on for two and one-half years and the total number of examinations was 243. Although a patient receiving over 10 mg. per day of prednisone or its equivalent in our Clinic normally is placed on a prophylactic ulcer regimen, such prophylaxis was given in only 7 of the 77 patients in this series. One of the 7 had a pre-existing peptic ulcer. Four were on unusually high dosage of steroids. Another had gastrointestinal symptoms prior to our study, and one had been on a prophylactic ulcer regimen elsewhere.

RESULTS

1. Base-Line Studies or Control Group: Of the 41 patients examined prior to institution of steroid therapy, only 2 (approximately 5 per cent) showed any roentgenologic abnormality. In each case this consisted of deformity of the duodenal bulb. One of these patients showed no change during steroid therapy; in the other active ulceration developed. Only 27

TABLE II: PEPTIC ULCERS OCCURRING DURING STEROID THERAPY

Patient	Normal Base-Line Study	Steroid Administered and Dose (mg./day) During the Four to Eight Week Period Prior to Demonstration of the Ulcer	Duration of Steroid Therapy Before Ulcer (months)	Description and Location of Niche	Healing and/or Behavior of Ulcer	Remarks	Prophylactic Regimen	Symptoms	Therapeutic Regimen
Z.K. 33	Yes	Prednisone, 60	18	Initial ulcer on greater curvature fundus. Second ulcer, antral on lesser curvature	Initial ulcer showed variable behavior, finally healing in 7 months. Second ulcer healed in 11 months	Reduction in steroid dosage after appearance of each ulcer. Change of drug to cortisone, 80 mg., after initial lesion; second ulcer developed while on this therapy	0	+	+
T.F. 18	Yes	MK 117, 20	3	Moderate size, prepyloric	Healing in 5½ months	16 alpha hydroxy hydrocortisone 20 mg./day during healing	0	+	+
S.R. 52	Yes	Prednisone, 20	18	Duodenal	Fully healed in 4 months	Eight G.I. studies before appearance of crater. Mucosal change preceded niche	0	+	+
J.G. 20	Yes	Methylprednisolone, 64	6	Duodenal	Healing in 5 weeks	Reduced dose and change of steroid after ulcer. Melena at time of diagnosis	+	+	+
O.J. 30	Yes	Triamcinolone, 48	10	Small, prepyloric	Healing in 5 months	Mucosal changes preceded niche; dose of steroid unchanged during healing	0	0	0
M.P. 50	Yes	Methylprednisolone, 36	7	Moderate size, antral, lesser curvature	Fully healed in 3 months	Psychosis. No symptoms	0	?	+
R.M. 36	Yes	Methylprednisolone, 144	2	Lesser curvature, mid-fundus	Healing in 2 months	Psychosis. No symptoms. Reduced dose of steroid during healing	+	?	+
D.M. 34	Yes	Dexamethasone, 3.5	16	No crater. Normal bulb, then deformity, 6 months later	Repeated examinations merely confirmed deformity	The only roentgenologic diagnosis made without demonstrating crater	0	+	+
L.J. 69	No	Methylprednisolone, 56	2½	Small, prepyloric, lesser curvature	Healing in 5 months	Healing on 10 mg. dexamethasone	0	0	0
A.C. 9	No	Prednisone, 12.5	9	Small, prepyloric, lesser curvature	No healing over a 10-month period	Steroid changed to 8 mg. methylprednisolone	0	+	
E.M. 46	No	Cortisone, 100		Lesser curvature, antral	Healing in 7 months	Reduced steroid dose during healing	0	+	+

TABLE II: PEPTIC ULCERS OCCURRING DURING STEROID THERAPY (*Cont.*)

P.B. 7	No	Cortisone, 75	72	Duodenal	Not observed		0	+	+
E.B. 64	No	Prednisone, 15	36	Duodenal	Healed in 2 months	Parenteral cortisone during healing	0	+	+
B.B. 8	No	Triamcinolone, 32	9	Small, pyloric	Healing within 1 year	Reduced steroid dose during healing	0	0	0
J.W. 63	No	Triamcinolone, 12	4	Initial ulcer pyloric. Second pyloric ulcer 4 months after healing of first	Initial ulcer healed 2½ months	Known previous ulcer and deformed bulb at start of steroid therapy. Reduced steroid dose during healing	+	+	+
R.B. 4		Triamcinolone, 32	4	Normal roentgenologic study. Death two months later	Autopsy proved perforated duodenal ulcer	Prednisone 100 mg./day given latter part of 4 months period of observation	+	+	+
S.S. 76		Dexamethasone, 18	4	Two normal roentgenologic studies	Two episodes of massive hematemesis	Ulcer regimen. Hematemesis subsided as did symptoms	0	+	+

of this group received steroids subsequent to the examination.

2. Steroid-treated Patients Examined Roentgenologically: Of the 63 patients receiving steroid therapy, 48 showed no evidence of active peptic ulceration. The comparative therapeutic data in this group and in those with positive evidence of ulcer are presented in Table I. Drug dosage was higher and duration of therapy longer in the group in which ulcer developed.

Peptic ulcer was demonstrated roentgenographically in 15 patients. In addition, 2 patients with normal radiographic findings were diagnosed as having peptic ulcer, giving a total incidence of 27 per cent. In 1 the diagnosis was made on the basis of a perforated duodenal ulcer proved at autopsy; in the other on the basis of repeated episodes of massive hematemesis. The data on all patients in whom ulcer developed are presented in Table II.

(*a*) *Location and Radiologic Appearance of Ulcers:* Of the radiologically demonstrable ulcers, 10 were gastric and 5 duodenal. Eight of the gastric ulcers were in the distal stomach and only 2 in its mid-portion. One of the larger antral ulcers is shown in Figure 1 (Patient E.M.). One gastric ulcer was located on the greater curvature, Figure 2 (Patient Z.K.). This appeared after eighteen months of corticosteroid therapy. A gastrointestinal study six months previously did not show it. In several instances, gastric ulcers were shallow and surrounded by mucosal edema, as emphasized by other workers (14, 17, 18). One example of such an appearance is illustrated in Figure 3 (Patient T.F.); A study three months before had been normal. In many instances, however, the gastric ulcers associated with steroid therapy did not differ in appearance from those in patients not receiving steroids. In a few instances in which many examinations were performed, mucosal changes, presumably due to edema, preceded the appearance of a gastric niche. This was also demonstrated in 1 case of duodenal ulcer. Figure 4,A shows an

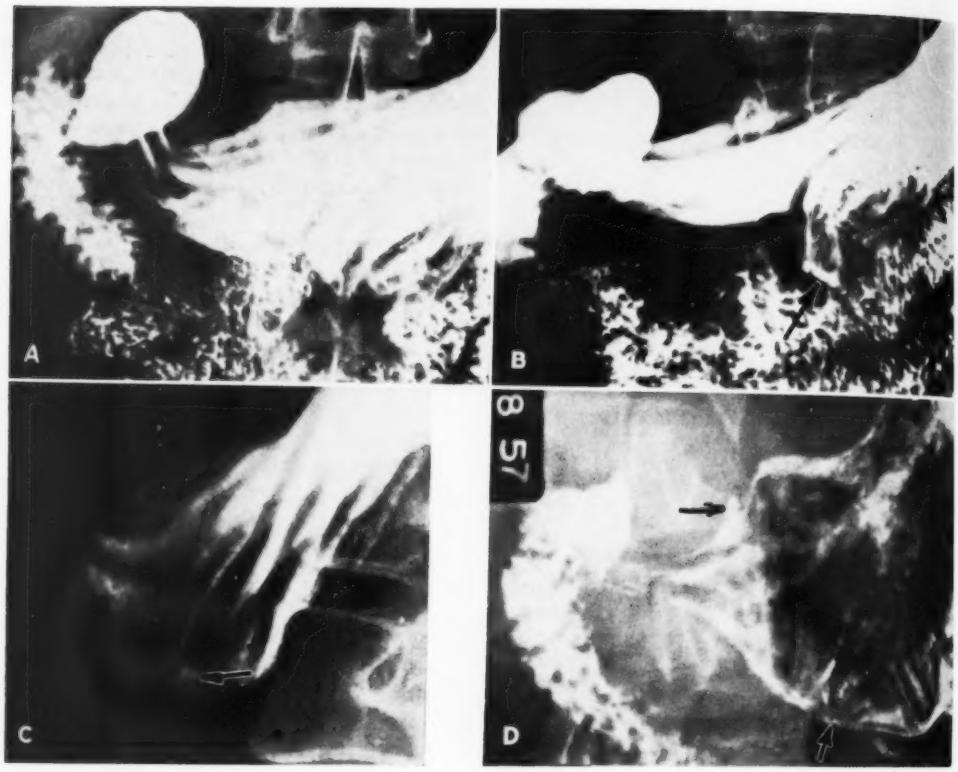

Fig. 2. Patient Z. K.

A. After twelve months of corticosteroid therapy, the mucosa is abnormal, but no ulcer niche can be seen.
B. Roentgenogram obtained after eighteen months of steroid administration. A large, greater curvature niche (arrow) is demonstrated.
C. Two months later, on reduced dosage of corticosteroids and an ulcer regimen, there was marked reduction in size of the greater curvature niche (arrow).
D. Five months later. Only radiating folds remain at the site of the greater curvature ulcer (lower arrow), but a small new niche has appeared on the lesser curvature of the antrum (upper arrow).

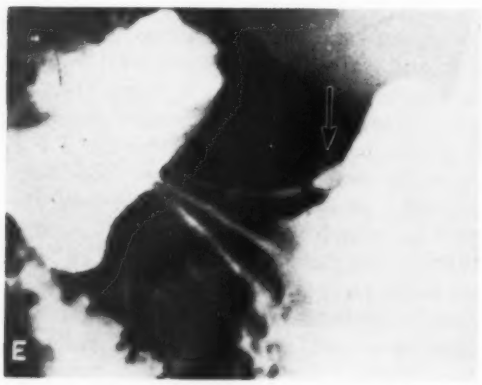

Fig. 2,E. One month after D. Lesser curvature ulcer is still present (arrow).

entirely normal duodenal bulb (Patient S.R.) prior to steroid therapy. Six gastrointestinal studies at intervals of three months showed gradually increasing mucosal edema until, eighteen months after the beginning of steroid therapy, the frank ulcer and mucosal changes seen in Figure 4,B appeared. The other 4 duodenal ulcers were not unusual in appearance or location. Only 1 diagnosis of ulcer was made without demonstration of a niche. In this case a normal gastrointestinal study was followed by observation of a deformed duodenal bulb.

(b) Sex Incidence of Peptic Ulcer in Steroid-Treated Patients: Of 12 males,

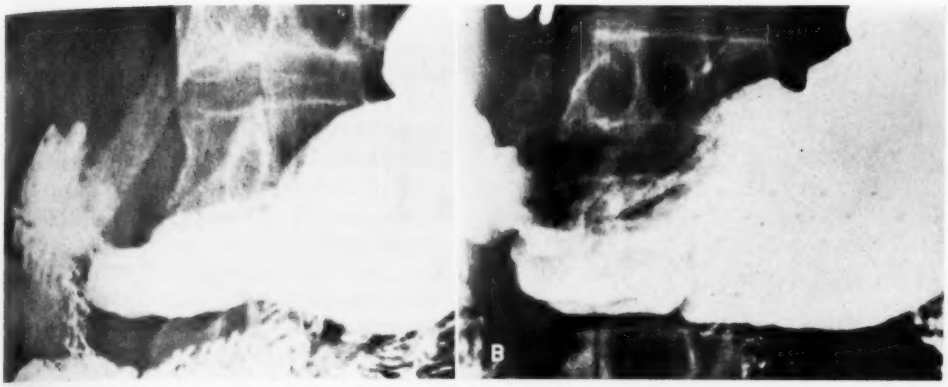

Fig. 3. Patient T. F. A. Normal gastrointestinal study prior to steroid administration. B. Shallow prepyloric ulcer appearing after three months of corticosteroid therapy (arrow).

5 (41 per cent) were found to have ulcer, as compared to 12 (24 per cent) of 51 females.

(*c*) *Correlation of Ulcer Incidence with Length of Treatment:* The duration of steroid therapy in patients with peptic ulcer is given in Table II and is compared with that in the group without ulcer in Table I. In all but 6 instances, steroid therapy had been administered for more than six months before peptic ulcer was diagnosed. The minimum time for the roentgenographic appearance of an ulcer was two months. It is noteworthy that in this exceptional case a dose of 144 mg. methylprednisolone was administered daily. From Table I, it is evident that the average period of steroid treatment under roentgenologic observation was considerably longer in the patients with ulcer than in those with normal roentgen studies.

(*d*) *Correlation of Ulcer Incidence with Dose:* The specific dosage data for each patient in whom ulcer occurred are given in Table II. The considerably higher median dose and the dose ranges in the patients with ulcer compared to those without ulcer is demonstrated in Table I. Table III, however, presents the most striking correlation of steroid dosage with ulcer incidence. Since there was no difference in occurrence of peptic ulcer with various drugs, dosage is expressed in milligrams of prednisone equivalent by use of conversion factors appended to the table. Ulcer incidence of 23 per cent with dosages of 40 to 59 mg./day and of 47 per cent with dosages over 60 mg./day furnishes a striking correlation. The minimum dose of individual drugs (mg./day) associated with occurrence of peptic ulceration is: prednisone and prednisolone 12.5; triamcinolone 32.0; methylprednisolone 36.0; dexamethasone 3.5. Although the dose for prednisone seems lower than the rest, this difference is only suggestive. In 2 patients who were receiving 12.5 and 15 mg. of this hormone per day immediately prior to their initial base-line examination, ulcers were demonstrated. Both had re-

TABLE III: CORRELATION OF STEROID DOSAGE AND ULCER INCIDENCE

Dosage in Mg./Day Expressed as Prednisone Equivalent	Total Number of Patients	Number of Patients with Ulcer	Percentage of Patients with Ulcer
Under 10	6	0	0
10–19	23	3	13
20–39	26	1	4
40–59	13	3	23
Over 60	17	8	47

Conversion Data for Individual Steroids

Steroid	Equivalent Units
Prednisone and Prednisolone	5
Triamcinolone	4
Methylprednisolone	4
Dexamethasone	0.75
Cortisone	25
Hydrocortisone	20

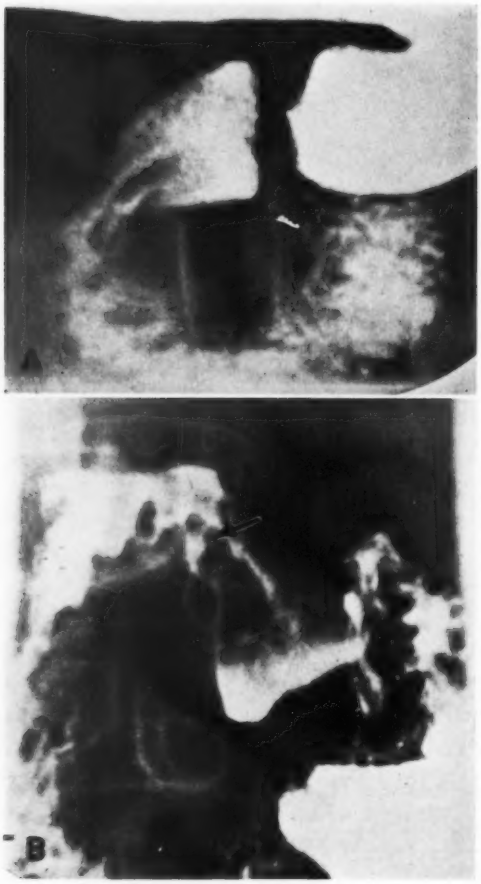

Fig. 4. Patient S. R. A. Normal duodenal bulb prior to corticosteroid therapy. B. After eighteen months of steroid therapy, marked mucosal edema and reproducible crater on the distal, lesser curvature aspect of the duodenal bulb (arrow).

ceived larger doses of this hormone many months before.

(e) *Behavior of Ulcers:* In the single patient who showed a deformed bulb following a normal gastrointestinal study, repeated examinations showed only persistence of the deformity. One patient was lost to observation following demonstration of a single active ulcer. In another niche persisted for ten months. Twelve patients who were followed by serial roentgen studies after the appearance of an active ulcer showed healing, and this observation of behavior is one of the unique features of this study. Perhaps the most unusual phenomenon was the occurrence of healing in 2 patients (O.J. and L.J.) at the end of five months without either an ulcer regimen or reduction in steroid dosage; both were asymptomatic. The ulcers in the other 10 patients healed with reduced steroid dosage and/or administration of an ulcer regimen. Healing time was variable, in the majority between five and twelve months. While healing was observed, it must be remembered that there were 2 patients with recurrences and that ulcer behavior was most unfavorable in 2 additional patients, with one instance of repeated hematemesis and one fatal perforation.

Figure 2 illustrates an example of healing and recurrence of peptic ulcer under continued steroid therapy. Mucosal changes without an ulcer niche were seen twelve months after initiation of steroid treatment (Fig. 2,A). Six months later (Fig. 2,B), a large ulcer had developed on the greater curvature. Within two months after this, following reduced dosage and an ulcer regimen, this had progressed favorably (Fig. 2,C). At the end of another five months, the initial greater curvature niche had disappeared completely (Fig. 2,D), but an entirely new small ulcer was present on the lesser curvature. The second ulcer persisted for slightly more than one month (Fig. 2,E).

(f) *Association of Ulcers with Symptoms:* Two patients with peptic ulceration were asymptomatic. Two others were psychotic. In the rest of the group (76 per cent) subjective manifestations varied from classic postprandial pain, relieved by food, to heartburn and vague upper abdominal distress. When gastrointestinal complaints in the non-ulcer as well as the ulcer groups were tabulated, it was found that, of a total of 63 patients treated with steroids, 28 had gastrointestinal symptoms. Twelve of these had peptic ulcer and 16 did not. There was no variation in incidence of subjective distress when one steroid was compared with any other. Generally, the occurrence of symptoms coincided with positive roentgen findings,

but in 1 case symptoms preceded demonstration of an ulcer by seven months.

(g) *Influence of a Prophylactic Ulcer Regimen:* Four of the patients in whom peptic ulcer developed had been on a prophylactic ulcer regimen for some time prior to the demonstration of the lesion. One of these had a known gastric ulcer two years before steroid therapy and a deformed bulb when therapy was initiated. The others were the patients receiving the highest dosages of steroids in the entire group—prednisone 100 mg., triamcinolone 96 mg., and methylprednisolone 144 mg. per day, respectively. Only 3 patients in the non-ulcer group were given prophylaxis.

COMMENT

With the employment of high dosages of the newer steroids, the incidence of peptic ulcer has risen compared to that occurring when cortisone alone was available. The influence of dosage upon incidence is emphasized by the findings in two studies. Kern *et al.* (12) found an ulcer incidence of approximately 20 per cent when 20 mg./day of prednisone or its equivalent was administered, and none with 15 mg./day or less. Kammerer *et al.* (17, 18) showed an even more striking correlation, with an almost tenfold increase in incidence with a dosage of 10 mg./day or more of prednisone or equivalent compared to amounts of less than 10 mg. Correlation of ulcer occurrence with length of treatment is not so clear, although in the series with the highest rate of ulceration (17, 18) all patients were treated for more than six months.

In our series of 77 patients undergoing numerous roentgen examinations over a long period of time, there was no unusual incidence of ulcer in the control group, and an incidence of approximately 27 per cent in the group receiving steroid therapy. The ratio of gastric to duodenal ulcers was notable—2:1 as compared to the normal expectation of 1:10. Eighty per cent of gastric ulcers were in the distal stomach. In a few patients undergoing numerous serial studies, it was possible to observe the roentgenologic evolution of an ulcer from the earliest mucosal changes to appearance of a niche (Fig. 4). Whether or not similar findings would occur in cases of peptic ulcer not associated with steroid therapy, should serial examinations equal as to number and chronologic spacing be carried out, is not known. Should such be the case, the significance of unusual mucosal changes without a niche, which are seen in roentgenologic practice, would be clarified. The relation of incidence to dose was very striking, with a rise to 47 per cent with 60 mg./day or more of prednisone or its equivalent. Two individual cases further emphasize the danger of high steroid dosage. In 1 patient a gastric ulcer developed after two months on a daily dose of 144 mg. of methylprednisolone, and the other suffered a fatal perforation while receiving 100 mg. of prednisone daily. Most ulcers appeared after six months of treatment, and length of treatment seemed to be significant in development of this therapeutic complication.

The multiple radiologic studies of our patients allowed observation of the behavior of ulcers with continued steroid administration. Only fragmentary observations of this kind have previously been available. Laitinen *et al.* (19) observed fairly prompt healing in 7 patients with continued steroid administration. In our material, in most instances, steroid dosage was reduced and a standard antiulcer regimen instituted after discovery of an active ulcer. Under these conditions almost all ulcers healed, although five months or more were required in 60 per cent of these patients. Even more benign behavior was seen in 2 patients. In these, ulcers healed in five months without reduction in steroid dosage and without an ulcer regimen. Interestingly, these were 2 of the 3 asymptomatic ulcers in the group. In contrast to such a favorable course, there were 2 patients with recurrent ulcers and 3 with even more serious complications: a fatal perforation

in 1 and massive hemorrhage in the other 2. Thus, behavior of steroid-associated ulcers must be considered unpredictable, but potentially unfavorable.

CONCLUSIONS

1. In 41 of 77 patients, almost all with diagnoses of systemic lupus erythematosus, examined roentgenologically prior to steroid therapy, there were only two abnormal studies, both demonstrating duodenal bulb deformity.

2. In 63 steroid-treated patients there was a 27 per cent incidence of peptic ulcer.

3. Gastric ulcer predominated over duodenal ulcer and there was unusual frequency of ulceration in the distal as compared to the proximal portion of the stomach.

4. A striking correlation between steroid dosage and ulcer incidence was observed. To a lesser degree, length of treatment was a factor in incidence. There was no variation in the effect of individual steroids.

5. The behavior of steroid-associated ulcers was unpredictable. Even with continuation of treatment, healing, although delayed, was the rule. Hemorrhage and perforation, however, are constant threats.

6. Gastrointestinal symptoms were usual in association with peptic ulcer in this series.

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SUMMARIO IN INTERLINGUA

Ulcere Peptic, Associate con Therapia Corticosteroidic: Studios Roentgenographic Serial

Con le uso de alte doses del nove preparatos steroidic, le incidentia de ulcere peptic ha montate in comparation con illo existente post le uso de cortisona sol. Con le objectivo de correlationar le incidentia de ulcere con le nivello de dosage, con le duration del therapia, e con le droga particular empleate, un serie de 77 patientes esseva examinate. Sexanta-tres de istes recipeva relativemente alte doses de steroides, principalmente como therapia de lupus erythematose. Studios roentgenologic in serie esseva effectuate durante un considerabile periodo de tempore. In 41 del casos, etiam examines ante le institution del therapia steroidic esseva possibile.

Inter le 63 patientes con alte doses steroidic, le incidentia de ulcere peptic esseva 27 pro cento. Ulceres gastric predominava super ulceres duodenal, e in un inusualmente alte proportion del casos le ulceration esseva in le portion distal plus tosto que proximal del stomacho. Un frappante correlation esseva notate inter le dosage de steroide e le incidentia de ulcere. Etiam le duration del tractamento, ben que a grados minus marcate, esseva un factor in le incidentia. Esseva notate nulle variation in le effectos inter le diverse steroides. Le comportamento del ulceres associate con steroides esseva impredicibile. Mesmo con le continue tractamento steroidic, le curation del ulcere—ben que relentate—esseva le regula. Hemorrhagia e perforation es nonobstante un periculo permanente.

Sign of the Burnous in the Stomach[1]

CHRISTIAN V. CIMMINO, M.D., F.F.R.

A BURNOUS is a cloak-like garment and hood woven in one piece, worn by Arabs and Moors. The term has been fancifully applied to the radiologic appearance of the disposition of the mucosa in the cardial segment of the stomach (1). The crescentic fold (hood of the garment) points cephalad, and the longitudinal folds (cloak) stream caudad from a point just beneath (Fig. 1). This mucosal arrangement has been called also a stellate impression, and has been related to the mucosa of the distal end of the esophagus (2). "Stellate," implying a 360° symmetry, is inappropriate: the cephalic fold is not continuous around a center, but is open caudad, and through this breach run the longitudinal folds of the lesser curvature of the stomach, continuous with those of the lower esophagus. An occasional patient will, it is true, present the appearance of a 360° continuity of the crescent, but this is due probably to the fortuitous superimposition of another gastric fold distally or of the distal fundal contour in a cascade stomach.

Fig. 1. Normal burnous. Upper three arrows indicate crescentic hood; lower two arrows indicate folds of the "garment."

If one examines stomachs postmortem by an incision high on the lesser curvature, with the surrounding viscera undisturbed, preferably with the left side of the body elevated, he will see in certain cases at the opening of the esophagus the characteristic pattern of the gastric mucosa that gives the radiologic sign of the burnous, and that this sign is not related to the mucosa of the lower esophagus (Fig. 2). The crescent corresponds to a definite mucosal fold seen to the left and above the esophageal opening, and mucosal folds may be seen streaming from this opening toward the lesser curvature. The reader must examine the beautifully

TABLE I. FREQUENCY OF SIGN OF THE BURNOUS ACCORDING TO AGE AND SEX

	Male			Female		
Age	Present	Absent	Total	Present	Absent	Total
10 to 19	2	2	4	0	1	1
20 to 29	3	5	8	5	4	9
30 to 39	3	8	11	4	8	12
40 to 49	3	12	15	5	12	17
50 to 59	2	8	10	1	8	9
60 to 69	0	5	5	3	7	10
70 and above	2	5	7	0	2	2
TOTALS	15 (25%)	45	60	18 (30%)	42	60

[1] From Mary Washington Hospital, Fredericksburg, Va. Accepted for publication in April 1960.

Fig. 2. Normal autopsy specimen of the cardial region of the stomach. Note the crescentic fold above and to the left of the esophageal orifice, and the rugal folds streaming downward in the lower left corner.

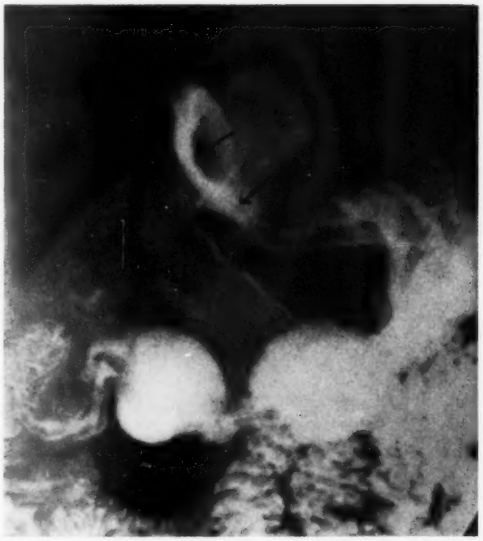

Fig. 3. Leiomyosarcoma. Upper arrow shows pressure of the tumor upon the vestibule of the esophagus. The lower three arrows show the caudal displacement and distortion of the burnous by the tumor. The presence of the burnous, even though distorted, indicates that the tubular structure filled with barium is esophagus and not sliding hiatal hernia.

illustrated paper of Jutras for additional pictures of the burnous. He will find, too, further discussion of the possible role of the crescentic fold as a water-tight seal in the closing mechanism of the distal esophagus in my own review of the radiologic status of the esophagogastric segment (3). The frequency and method of demonstration of the burnous at the autopsy table will be considered in a future paper.

TABLE II: FREQUENCY OF SIGN OF THE BURNOUS ACCORDING TO PROJECTION IN 120 PATIENTS

Anteroposterior	0
Postero-anterior	14
Oblique	28
Lateral	12
Burnous seen in one view	21
Burnous seen in two views	6
Burnous seen in three views	7

The postero-anterior, anteroposterior, oblique, and lateral studies which comprise the core of my gastroduodenal examinations were studied from 120 consecutive cases to determine the frequency of the sign of the burnous. Tables I and II summarize the data. The difference in frequency between the male and female is not statistically significant (less than 1 sigma). The sign was seen most commonly in the oblique view, not only since this is the most satisfactory projection but also because it affords the most favorable ratio of gas to contrast material in the cardial region. The real frequency of the sign of the burnous is probably much higher than the figures indicate, because, unless the sign was incontrovertible, it was not said to be present.

I have come to regard the presence of this sign as comforting corroborative evidence that all is well in the cardia and fundus. These regions have always given the radiologist difficulty in the diagnosis not only of esophageal hiatal hernia but also of neoplasia. The sign of the burnous is present sufficiently often to give it worth; its absence, however, is of no diagnostic value.

Fig. 4. Biopsy-proved cirrhosis; radiologically demonstrated varices in lower esophagus. Upper three arrows indicate crescentic hood of burnous. Lower two arrows indicate gigantic folds, probably gastric varices.

Pathology of the Cardia and Fundus as Related to the Burnous: 1. *Hernia:* The sign of the burnous cannot be present, obviously, in its normal position beneath the diaphragm in association with a sliding esophageal hernia, since in that condition the cardial region is displaced upward through the esophageal hiatus. Although, as noted above, the absence of the sign is not significant, no epiphrenic accumulation of barium can represent a true sliding hernia if the burnous is present in its normal position. I have considered the problem of diagnosis of hiatal hernia and the several sources of error, especially the identification of the esophageal hiatus in relation to the diaphragm, in a previous paper (3).

2. *Neoplasia:* Figure 3 shows the burnous severely distorted and displaced by a fundal leiomyosarcoma.

3. *Gastric mucosal abnormality:* Figure 4 shows giant longitudinal folds, obviously abnormal, streaming beneath the crescentic fold in a patient with proved cirrhosis and radiologically demonstrated esophageal varices and splenomegaly.

SUMMARY

1. The sign of the burnous, named for a type of hooded garment worn by Arabs and Moors, is produced by the disposition of the mucosa in the cardial segment of the stomach. It was found in 27 per cent of stomachs in 120 consecutive gastrointestinal examinations.

2. While its absence is of no diagnostic significance, its presence is a satisfying corroborative sign that all is well in the cardial and fundal segments.

3. The sign of the burnous cannot be present undisturbed in association with a sliding hiatal hernia. It may be distorted by neoplasm in the cardial-fundal area, or by varicose or inflammatory disease of the longitudinal folds as they stream beneath the crescent from the esophagus into the stomach.

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SUMMARIO IN INTERLINGUA

Le Signo del Burnus in le Stomacho

Le signo del burnus—nominate assi a causa de su conformation que suggere illo del burnus del arabes e moros (le qual es un vestimento a cappucio)—es producite per le disposition del mucosa in le segmento cardial del stomacho. Illo esseva notate in 27 pro cento del stomachos in 120 consecutive examines gastrointestinal.

Durante que su absentia es sin signification diagnostic, su presentia es un benvenite signo corroboratori que toto es in bon ordine in le segmentos cardial e fundal.

Le signo del burnus non pote esser manifeste indisturbate in le presentia de un glisante hernia hiatal. Illo pote esser distorquite per neoplasma in le area cardiofundal o per morbo varicose o inflammatori del plicas longitudinal ubi illos flue infra le crescente ab le esophago a in le stomacho.

Esophageal Moniliasis[1]

S. A. KAUFMAN, M.D., SAUL SCHEFF, M.D., and GEORGE LEVENE, M.D.

NOW THAT antimicrobial and cellular toxic agents are available, patients with chronic fatal disease survive longer than formerly. Their poor general condition, however, along with repeated courses of antibiotics, predisposes to an increased incidence of moniliasis.

The causative microorganism of this disease (*Candida albicans*) is seldom, if ever, found in the normal skin. It is a common inhabitant of the gastrointestinal tract, where it does not usually cause symptoms. When the host resistance is lowered, and the relative virulence of the organism is perhaps increased by antibiotics, infection becomes manifest, producing the various clinical characteristics of candidiasis. The disease, however, may be primary when the organism, for some obscure reason, becomes more virulent and attacks the host. Direct microscopic examination of material from the lesion may reveal the yeast-like fungus, which is readily grown on dextrose, cornmeal, or Nickerson's agar, and is easily identified. Skin tests (oidiomycin) have been of little help as a diagnostic procedure (6).

The common sites of infection are the mouth, skin, vagina, and respiratory tract. Esophageal infection is an unusual but important form of the disease, which produces fairly characteristic roentgenographic findings and can easily be confirmed by myocologic studies.

In the chronically ill, debilitated patient with a sudden onset of dysphagia, it is important that the possibility of monilial esophagitis be considered. If untreated, the disease may be progressive and contribute to the rapid deterioration and death of the patient. Recognized and treated early, it is relatively innocuous and the symptoms are readily relieved. While esophageal infection may extend from the mouth, it can occur without any evidence of thrush or moniliasis elsewhere.

Esophageal moniliasis is manifested by the fairly sudden onset of painful, difficult swallowing in a patient with a history of a debilitating disease, repeated infections, leukopenia, and intermittent or sustained treatments with antibiotics and steroid hormones. The dysphagia is progressive and the patient may shortly be able to take only fluids. In the presence of oral moniliasis there may be associated soreness of the mouth. With the institution of specific therapy early in the course marked reversal of the symptoms has occurred. Within forty-eight to seventy-two hours the pain on swallowing abates and the patient is able to eat again.

The roentgenographic findings on barium swallow are quite distinctive. The involved portion of the esophagus shows irritability and spasm. The mucosa has a peculiar granular, cobblestone appearance, which may be limited to a segment of the esophagus or extend throughout its length (Figs. 1 and 2). This appearance is due to a pseudomembranous lining, consisting of *Monilia* and debris. Hyperemia, inflammation, and edema of the deeper layers are associated with the mucosal ulceration (Figs. 4 and 5). If untreated, the lesion progresses and the mucosa assumes an irregular, shaggy appearance, with complete loss of normal pattern. The esophageal lumen becomes narrowed and the walls rigid (Fig. 3). In early cases the changes in the esophagus rapidly improve following treatment, and within two to four days it may appear normal. Residual irritability may persist for a week or longer.

In the newborn, oral monilial infection and the development of clinical thrush are relatively common. Monilial dermatitis is also frequently noted in the diaper area as well as in other skin flexures. Children

[1] From the Department of Radiology of the Massachusetts Memorial Hospitals and Boston University School of Medicine, Boston, Mass. Accepted for publication in March 1960.

Fig. 1. G. S., an 80-year-old female with chronic lymphatic leukemia. A and B. Barium swallow study two days following onset of progressively severe dysphagia, showing marked irregular coarseness of the esophageal mucosa in the upper two-thirds. The esophagus was somewhat rigid and contained a myriad of small filling defects, producing an almost "bubbly appearance." A small diverticulum is present, which was also infected. The diagnosis of monilial esophagitis was confirmed by direct smears from the hypopharynx. Treatment with oral Mycostatin (mouth washes were slowly swallowed) relieved the dysphagia in two days. There was no evidence of oral thrush.

C. Four days following institution of treatment, the esophagus was irritable and the mucosa irregular but improved.

D. Three days later the esophagus appeared normal.

dying in the neonatal period from infantile diseases such as intestinal obstruction, renal disturbances, and gastrointestinal abnormality often manifest widespread monilial infection in the lungs, digestive tract, genitalia, and other viscera. While these infections are not usually fatal, they serve as an index of debility.

In older children, infection with *Candida albicans* is frequently observed in leukemia and in severe chronic pulmonary infections, especially in association with fibrocystic disease of the pancreas. At necropsy extensive ulceration of the pharynx, esophagus, and stomach is found. The organisms are isolated from the gastrointestinal tract, the bronchioles, and alveoli of the lung. A form of *Candida* septicemia producing granulomatous lesions in various viscera has been described but is rarely seen (1). Esophageal moniliasis in a four-year-old child with refractory aplastic anemia was recently reported by Kaufmann (2). Roentgenologic examination revealed multiple filling defects and marked irregularities of the mucosa throughout the length of the thoracic esophagus. The appearance resembled varices, but that diagnosis was unlikely in view of the clinical findings. At necropsy the esophageal wall was thick and the mucosa irregular and ulcerated. The layers of the wall were invaded by clusters of pseudomycelia with pseudohyphae and yeast-like cells.

In adults, monilial infection is common in the chronically ill. Andrén and Theander (3) described two patients with chronic illness of obscure origin characterized by leukopenia, splenomegaly, and severe recurrent infections. They had been treated with antibiotics, cortisone, and ACTH. Both had oral thrush and suffered from severe dysphagia. Roentgenographic changes in the esophagus consisted of a striking irregularity and jagged outline of the lumen and loss of mucosal pattern. Only the cervical esophagus was spared. Necropsy in one case showed an ulcerated esophageal mucosa lined with a pliable,

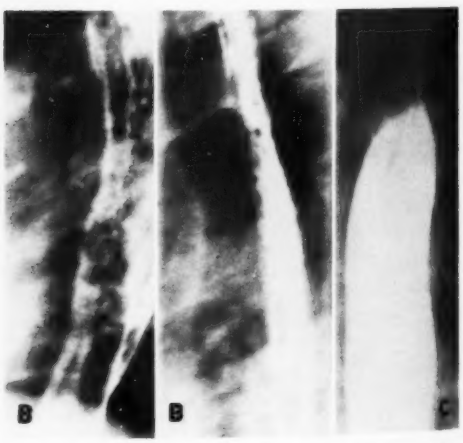

Fig. 2. R. D., a 43-year-old male with acute monocytic leukemia was rapidly succumbing to his disease. One day following the onset of dysphagia a barium swallow study was done (A and B). The esophagus was irritable and the mucosa had a cobblestone appearance. Mycostatin was administered orally and the dysphagia rapidly improved.
C. One week later the appearance following a barium swallow was normal.

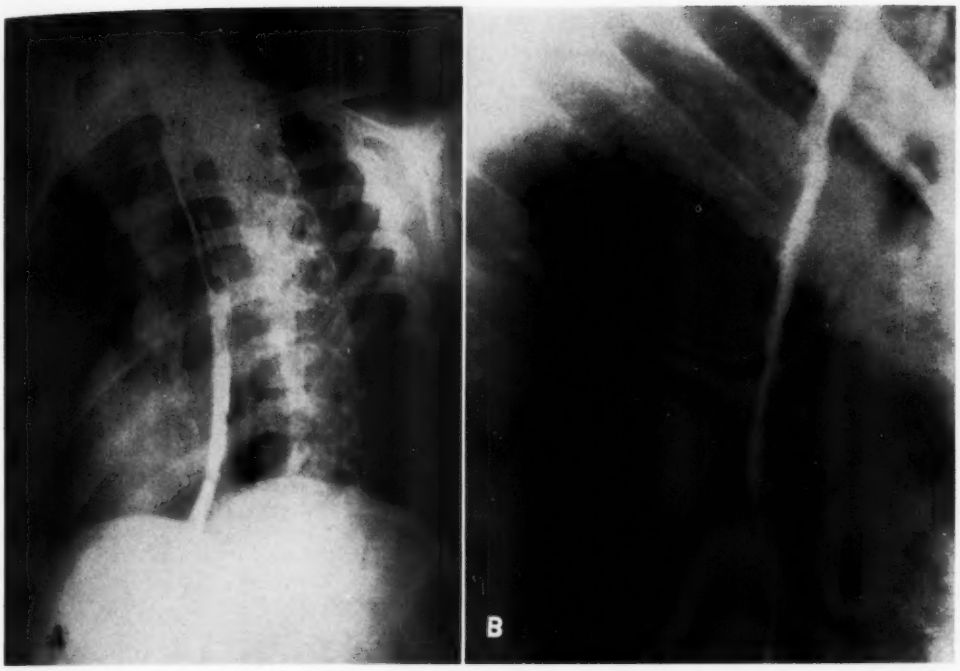

Fig. 3. L. M. A., 16-year-old boy with acute lymphatic leukemia. A. Barium swallow study obtained a few days following onset of epigastric and substernal pain on swallowing. The esophagus was irritable and the mucosa had an irregular, cobblestone appearance. B. Spot film obtained one week later (no specific treatment available) following a barium swallow, showing marked irregular narrowing of the lumen. The mucosal pattern was lost and peristalsis was absent. The patient at this time was able to take only small sips of fluid. He died a few days later. This case was previously reported (4).

yellow layer from which *Candida albicans* was cultured.

A case of esophageal moniliasis in a sixteen-year-old male with leukemia (Fig. 3) was described by Kaufman and Levene (4). The findings on x-ray examination and the changes at autopsy were similar to those in other reported cases. It is of interest that this patient did not have any evidence of oral moniliasis. On barium swallow the lumen of the esophagus showed marked narrowing due to a thick pseudomembrane of *Monilia* and debris. Ulceration and necrosis of the mucosa extended into the muscularis in many places. The instances of esophageal moniliasis described in the literature and two additional cases illustrated here (Figs. 1 and 2) seem to suggest a high incidence in chronic blood dyscrasias. This parallels the observations of Winter and Foley (5), who commented on the high incidence of this infection in children with leukemia.

The antibiotic nystatin (Mycostatin) administered orally has proved effective in treatment because of its inhibitory action on *Candida* in the gastrointestinal tract. Doses of 500,000 units three times a day will relieve dysphagia and pain, often within a day or two. Iodides, gentian violet, inhalation of brilliant green, and other agents have been advocated in the treatment of gastrointestinal and respiratory tract infection.

SUMMARY

Moniliasis is common in the chronically ill. Severe esophagitis may occur either by extension from the oral cavity or as an isolated infection. The disease may be uncovered early in its course by the striking radiographic findings following a barium swallow. Detected and treated early, esophageal moniliasis is relatively in-

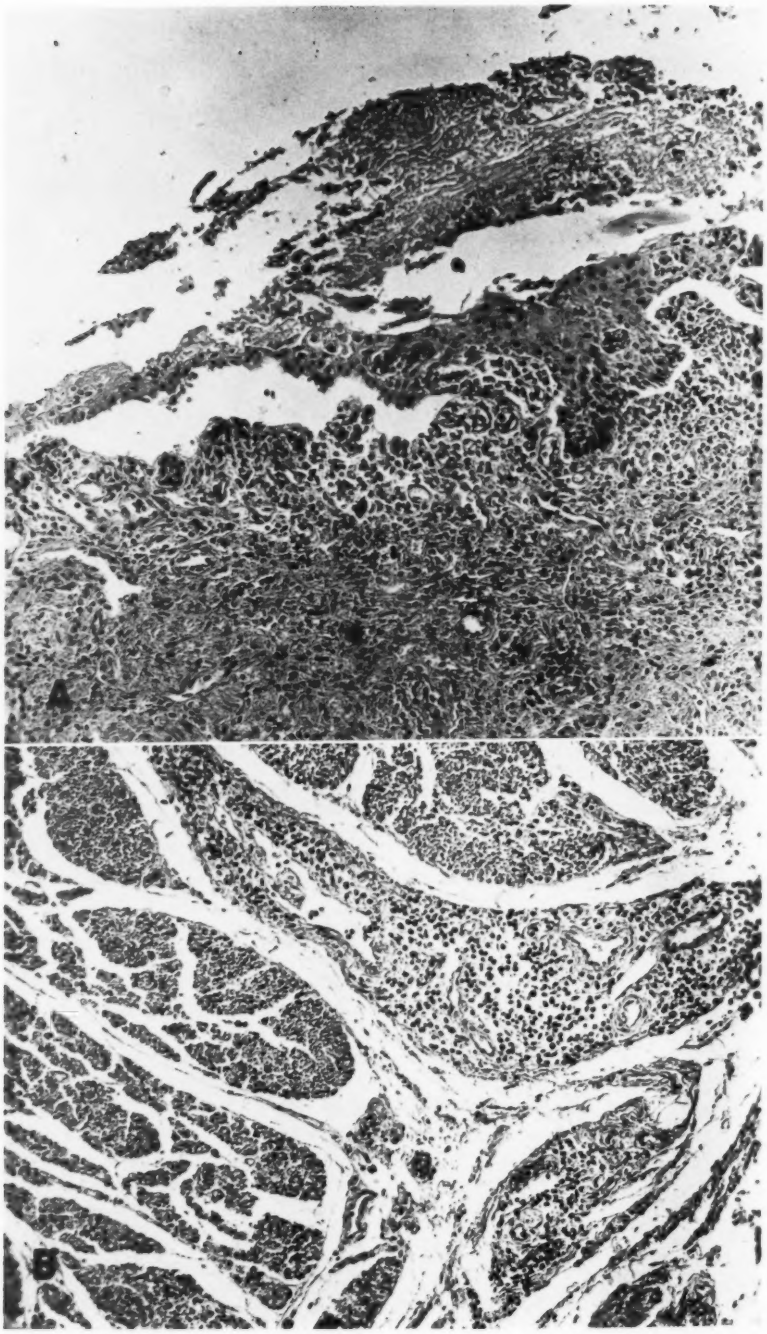

Fig. 4. Photomicrographs from case shown in Fig. 2. The patient suffered a relapse and his dysphagia returned. He succumbed to his disease before receiving treatment.

A. Low-power (×120) view of the esophagus, showing the ulceration of the mucosa down to the lamina propria. Hematoxylin-eosin.

B. Low-power (×110) section through the deeper layers of the esophagus, demonstrating cellular infiltration, as well as separation of the muscle fibers by extensive edema.

Fig. 5. Case shown in Figs. 2 and 4. Photomicrograph. Grocott stain. The ulcerated esophageal mucosa is particularly well shown, as are the aggregates of hyphae and spores The submucosal edema is not an artefact. (× 350)

nocuous and the symptoms are quickly relieved. Undetected, it progresses and may contribute to the patient's death. It is incumbent upon the radiologist to consider monilial infection of the esophagus in debilitated patients with sudden onset of dysphagia and pain on swallowing, since specific and effective treatment is readily available.

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(Pro le summario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Moniliasis Esophagee

Moniliasis es commun in le patiente con un maladia chronic. Sever esophagitis pote occurrer per extension ab le cavitate oral o como un infection isolate. Le morbo pote esser detegite precocemente in su curso per le frappante constatationes radiographic post un inglutimento de barium. Quando moniliasis esophagee es detegite e tractate promptemente, illo es relativemente innocue, e le symptomas es alleviate rapidemente. Quando illo remane non-detegite, illo progrede e pote devenir un factor contributori in le morte del patiente. Il es a expectar ab le radiologo que ille considera le possibilitate de un infection monilial del esophago in patientes in stato de debilitate con declaration subite de dysphagia e dolor in inglutir, proque un tractamento specific e efficace es facilemente effectuabile.

Roentgen Features of Diffuse Lymphosarcoma of the Colon[1]

BERNARD S. WOLF, M.D., and RICHARD H. MARSHAK, M.D.

LYMPHOSARCOMA with predominant or sole involvement of the colon is rare (1–3) and the roentgen features of this condition have not been emphasized. As elsewhere in the gastrointestinal tract, lymphosarcoma of the colon occurs in two main varieties: one, a discrete or localized form which presents as a single mass, and the other an extensive diffuse submucosal infiltrating variety extending over long segments of the bowel. Differentiation of the discrete variety from carcinoma on barium-enema examination is difficult but is suggested by dilatation of the lumen of the bowel in concentric fashion at the site of the lesion (Fig. 1, A) or by the presence of a bulky intramural mass with extensive extrinsic involvement (Fig. 1, B). Another discrete type is the endo-exocolonic or dumbbell variety, usually with a considerably larger extrinsic component (Fig. 1, C). There is no difficulty in differentiating the diffuse variety of lymphosarcoma of the colon from carcinoma. The roentgen features are quite characteristic and usually permit a correct diagnosis. They are comparable to the findings in the well known "giant rugae" type of lymphosarcoma of the stomach.

The diffuse form of lymphosarcoma of the colon is characterized pathologically (4) by extensive thickening of the submucosa as a result of infiltration with innumerable, closely packed, round cells. It is assumed that this process starts in the submucosal lymphoid follicles, which in places extend into the mucosa. It is not known whether it begins as a multicentric process or arises from a single area, later spreading by direct extension or through lymphatic channels. When patients with the diffuse type of lymphosarcoma of the colon are first seen, a large part of the colon is involved in a more or less uniform and continuous fashion. Submucosal infiltration extends, however, for

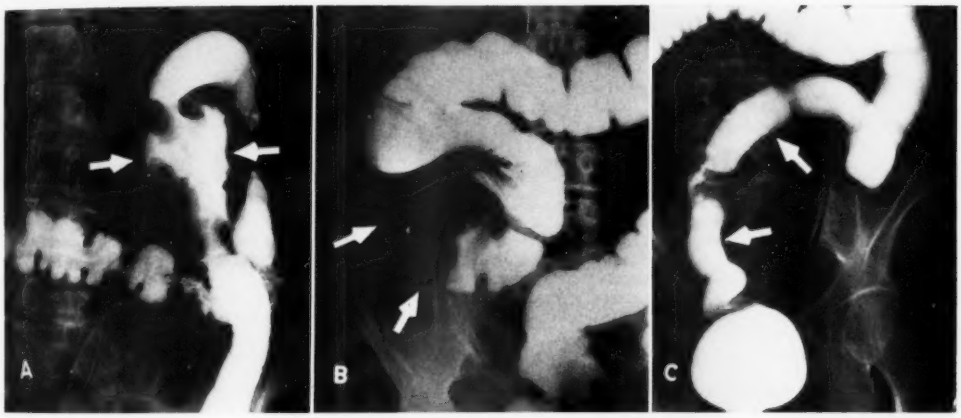

Fig. 1. Localized forms of lymphosarcoma of the colon.

A. A discrete mass is present in the distal limb of the splenic flexure (arrows). This measures 3 to 4 inches in length with minimal annular narrowing at each end. The central portion, however, is dilated in concentric fashion with destruction of the mucosa and a coarsely lobulated surface pattern.

B. The lumen of the caput coli is concentrically narrowed by a thick intramural mass. Extrinsic growth of the tumor is indicated by the large soft-tissue mass (arrows) at the level of the iliac crest.

C. A short segment in the mid-sigmoid is eccentrically narrowed with amorphous mucosal pattern. A large extrinsic mass is indicated, however, by displacement of the sigmoid loop (arrows). This is the "dumbbell" variety with the bulk of the tumor located extrinsically in the serosa or mesentery.

[1] From the Department of Radiology, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in April 1960.

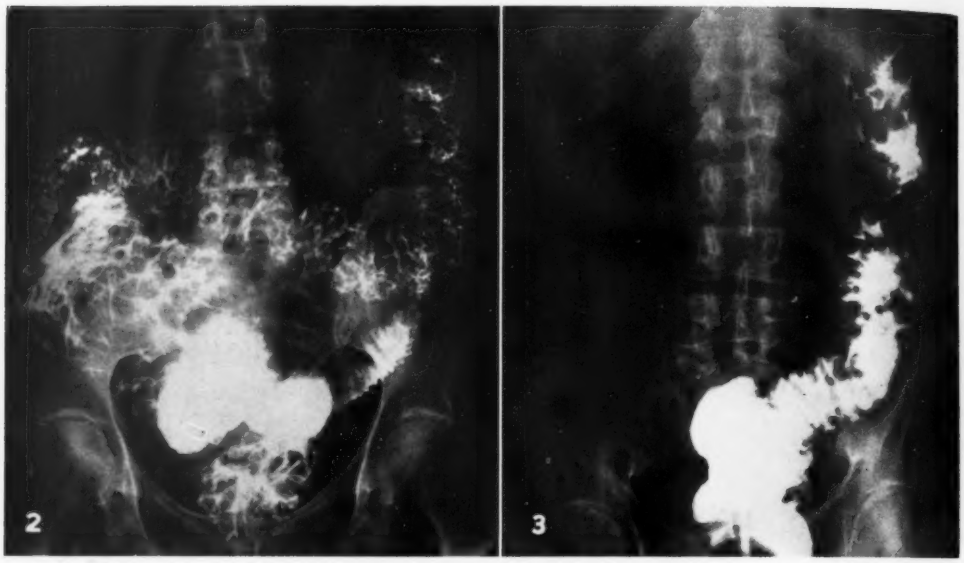

Fig. 2. Diffuse lymphosarcoma of the colon. Despite evacuation of much of the barium, the caliber of the contracted colon is large because of the hugely thickened and redundant mucosa and submucosa filling the lumen. The normal fold pattern is replaced by a reticulated surface which is extremely coarse in the cecum and relatively fine in the splenic flexure. In the cecum, the bulky sessile polypoid protrusions form a conglomerate mass. The barium in the interstices between the innumerable projections is sharply defined. No gross ulceration is evident.

Fig. 3. An incomplete barium enema shows thickening of the folds in the sigmoid, which becomes progressively more marked and irregular as the splenic flexure is approached. In this area, nodular projections fuse to cause obstruction to the retrograde flow of barium. There is, however, no evidence of anterograde obstruction; distention of the colon proximal to the splenic flexure is absent.

some distance from the area of obvious gross involvement and there may be additional lesions apart from that region. Marked involvement is most common in the ileocecal or the rectosigmoid areas, where the tumors sometimes become confluent and form a large conglomerate mass which may result in intussusception and incomplete intestinal obstruction. In the ileocecal region there is ordinarily extension of the process into the appendix and into the ileum for a variable distance. Involvement of the draining lymph nodes almost invariably accompanies disease of the colon. When the rectum is the site of the tumor, the inguinal nodes may be enlarged and palpable. Extensive serosal or retroperitoneal involvement is not characteristic of this variety of lymphosarcoma. On palpation, the bowel wall is markedly thickened and rubbery in consistency. The cut surface of the broad submucosa is homogeneously grayish white, with relatively few blood vessels. The most striking changes are observed when the mucosal aspect of the colon is inspected. The mucosa is thrown up into a huge number of convoluted folds which resemble the surface of the brain and individually may reach a thickness of one or two centimeters. Superimposed on the thick convolutions are innumerable broad-based intraluminal protrusions. While these may be termed pseudopolypoid, elongated thin pedicles are rare. Deep ulceration and perforation are uncommon, although areas of superficial mucosal necrosis may be present.

Clinically, unless there is involvement of peripheral or mediastinal nodes, the correct diagnosis is often not suspected. Males are said to be affected twice as often as females (2). In one series (1), the ages ranged from eleven to seventy. The complaints of the patient include progressive weakness, loss of weight, anorexia associated with some abdominal discomfort, and change in bowel habits. This

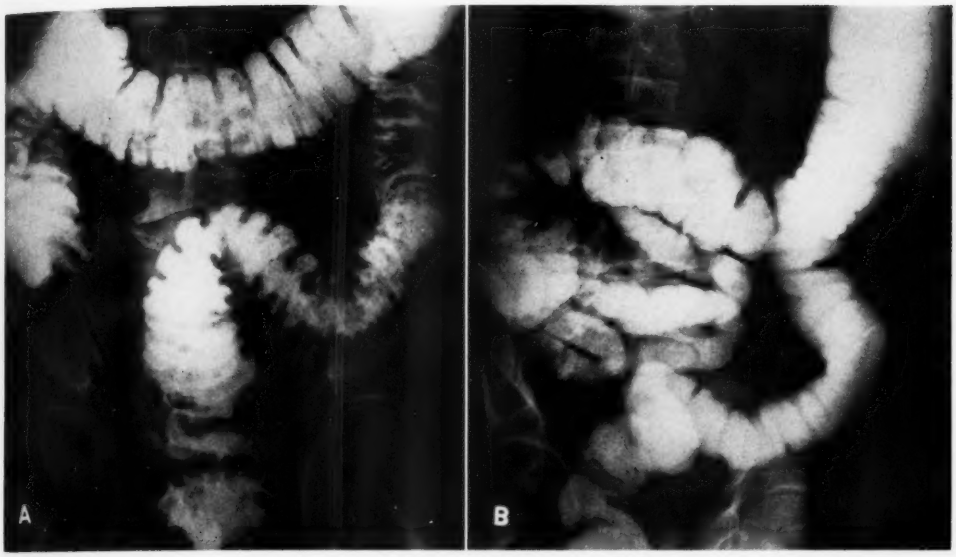

Fig. 4. Small-cell lymphosarcoma proved by inguinal node and rectal biopsy in a 72-year-old male.
A. Barium enema shows marked coarsening and multiple nodularities of the mucosal and fold pattern most prominent in the rectum, sigmoid, and descending colon. Distensibility appears to be increased rather than diminished. The haustral pattern is intact.
B. Re-examination was done eight months after betatron radiotherapy to the abdomen with an estimated mid-abdominal dose of 650 rads in five weeks. The colon shows no definite abnormality.

last may consist of constipation, but diarrhea or episodes of alternating diarrhea and constipation are more common. Gross blood in the stools is unusual, but blood streaking with rectal involvement is of frequent occurrence. Since fever may also be present, the diagnosis of ulcerative colitis may be made clinically. Discrete intra-abdominal masses are usually not palpable until late in the disease process. There is ordinarily a rather marked anemia. In some instances, the number of immature cells is increased both in the peripheral blood and in the bone marrow, but a leukemic picture is rare. With severe involvement of the rectum and sigmoid, an experienced sigmoidoscopist may suspect the correct diagnosis and confirm it by biopsy. In this area of the colon, there frequently are associated superficial inflammatory changes, and the diagnosis of ulcerative colitis suspected clinically may appear to be established unless biopsy is performed. Despite the absence of remarkable changes at sigmoidoscopy, biopsy should be done if the suspicion of lymphosarcoma is entertained, since positive findings may be found on microscopic examination. In the majority of cases, either prior or subsequent to the involvement of the colon, peripheral, cervical, or mediastinal adenopathy is noted. Splenomegaly, however, is not a characteristic finding.

In a severe case, barium enema examination shows a transformation of the mucosal pattern into an extremely irregular, cobblestone appearance with innumerable coarse folds and finger-like projections into the bowel lumen (Figs. 2–4). These findings are usually most obvious prior to complete filling of the colon or after evacuation. The colon is more distensible than anticipated and fails to collapse after emptying (Fig. 5, A and B). There is no remarkable irritability during filling with barium. The haustral pattern is maintained, the bowel is not shortened, and there is no evidence of mucosal ulceration. With complete filling, the intraluminal projections are obscured, although numerous closely spaced polypoid indentations usually persist along

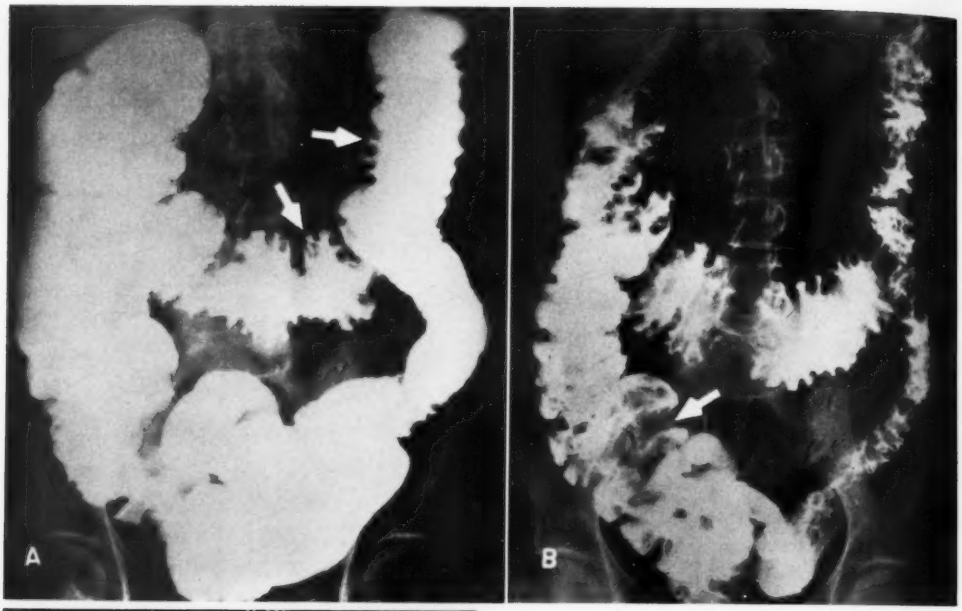

Fig. 5. A. The colon filled with barium shows increased distensibility, with numerous thick, finger-like indentations along the contour (arrows).

B. After evacuation, considerable barium remains in the poorly contractile colon. The "wild" mucosal pattern, with coarse reticulation superimposed on thick transverse folds, is more evident. A conglomerate mass is present in the region of the ileocecal valve (arrow).

C. After about 2,700 rads to the midabdomen (Co^{60} teletherapy) the colon appears almost normal. Several haustra (arrows) are still unusually broad.

the contour. When submucosal thickening is less pronounced, the filled colon may not appear remarkable. In such instances, after evacuation, a relatively fine, but obviously reticulated, nodular mucosal pattern (Fig. 6) may be present which, at first sight, is difficult to recognize as the result of a neoplastic process. In the filled bowel (Fig. 6) these fine nodularities may be manifest as innumerable small serrations or, instead, as rather flat, short, scalloped areas of limited distensibility (Fig. 7, A). Intussusception, if present, is ordinarily easily reduced, although a mass may persist in the region of the ileocecal valve and prevent filling of the terminal ileum (Figs. 7 and 8). Evacuation of the barium is frequently incomplete and irregular. In areas of severe involvement, the contracting "colon" succeeds in ridding itself of the barium but remains distended, with the thickened mucosa and submucosa filling its lumen. The most striking pictures are obtained under these circumstances (Fig. 2, A).

From the roentgen point of view, diffuse lymphosarcoma of the colon must be differentiated from familial polyposis, ulcerative

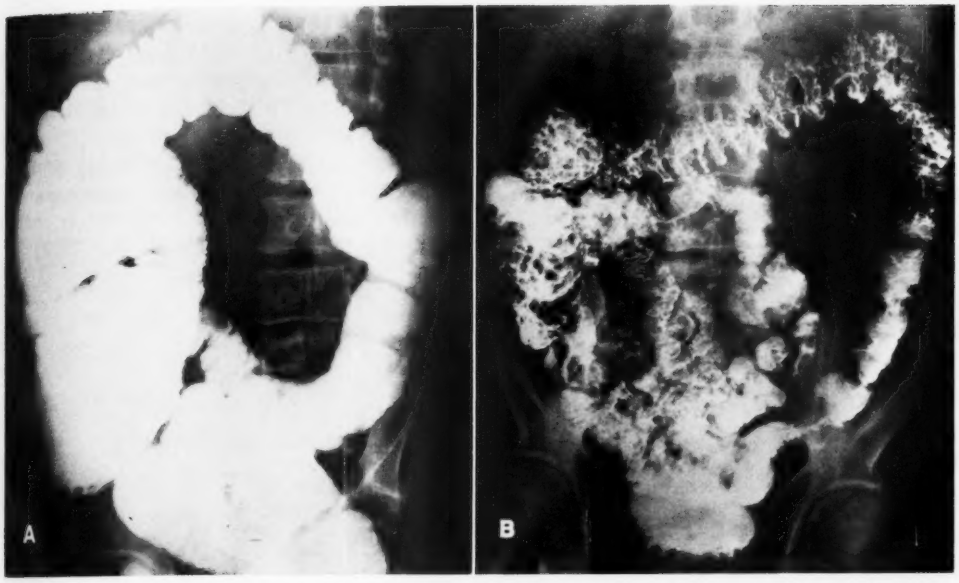

Fig. 6. A. Barium enema examination shows an unusually distensible colon with innumerable serrations along its contour. The caput coli shows larger tooth-like contour defects.
B. Evacuation film shows a remarkable complexity of the mucosal pattern throughout most of the colon, with relatively coarse nodulation in the cecum and ascending colon and fine reticulation in the transverse and descending colon. The terminal ileum is similarly involved.

colitis with pseudopolypoid changes, and granulomatous colitis or ileocolitis. In contrast to familial polyposis, the polypoid changes in lymphosarcoma are superimposed on a background of innumerable thickened folds and are due to sessile protrusions into the lumen. While these pseudopolyps may show slight narrowing at the base, the long pedicles characteristic of familial polyposis are rare. In the absence of carcinomatous transformation, the conglomerate or confluent masses seen in lymphosarcoma are absent in polyposis. Moreover, simultaneous extensive involvement of the ileum and the colon is not common in familial polyposis. In young patients without a previous history, final differentiation may depend on sigmoidoscopy and biopsy. Unlike ulcerative colitis, diffuse lymphosarcoma shows no ulcerations, the haustral pattern is preserved, and shortening, irritability, and deformity characteristic of the former disease are absent. A difficult problem may arise in differentiating lymphosarcoma from granulomatous ileocolitis, which may also present as a diffuse nodular thickening of the mucosa and submucosa. In ileocolitis there is eventually narrowing and deformity of the bowel with mucosal ulceration, irregular shortening, and eccentric pseudodiverticular formation. Very rarely, a single or several polypoid lesions in the rectum and sigmoid may be benign lymphomata or lymphadenomata which are recognized only after biopsy and confirmed by careful follow-up of the patient's subsequent course (5). Such benign polypoid lymphomatous "growths" may also occur elsewhere in the colon (6) but are not associated with diffuse infiltration and for that reason do not simulate lymphosarcoma.

Incidentally, we have not observed any case of Hodgkin's disease with diffuse colonic involvement. This is somewhat surprising, since Hodgkin's disease may exactly simulate the appearance of diffuse lymphosarcoma in the small bowel (7) and ileocecal region (Fig. 9). Hodgkin's disease of the colon seems to be much less frequent than lymphosarcoma, more

Fig. 7. A. Barium enema examination shows multiple flat and polypoid indentations along the contour of the cecum (lower arrows). However, additional areas of flat scalloping (upper arrows) are evident throughout the colon and rectum. An ovoid defect is faintly seen through the barium column in the region of the ileocecal valve. No barium entered the terminal ileum.

likely to cause narrowing of the lumen, and less responsive to radiation therapy.

DISCUSSION

Diffuse lymphosarcoma may occur in any portion of the gastrointestinal tract but is considerably more common in the stomach and small bowel than in the colon. Because of its extent and the simultaneous involvement of lymph nodes, operative resection is not likely to be successful. There presumably are instances of colonic involvement intermediate between the discrete and diffuse forms in which resection might be considered. In the small number of cases observed, radiotherapy has been surprisingly effective in controlling the disease for a limited period of time. One patient (Fig. 6) did extremely well for about three years. Because of the poor general condition and the extensive area of the abdomen which must be irradiated, therapy should be started with relatively small doses, that is, 20 or 30 rads per treatment, to the mid-abdomen.

The systemic and hematologic response of these patients to radiotherapy appears exaggerated. Inasmuch as leukopenia may be rapidly induced by relatively small amounts of radiation, the blood count must be carefully observed during the course of treatment. In one instance it was possible to deliver 3,500 to 4,000 rads in about twelve weeks (Fig. 5). A smaller total dose may, however, be effective in inducing a remission. In one patient a total midabdominal dose estimated at 650 rads, delivered in five weeks, produced remarkable improvement in the appearance of the colon (Fig. 4) and a clinical remission which at the time of this report had persisted for about a year. The patient who did well for three years received only 800 rads to the mid-abdomen in approximately eight weeks.

B. Small-bowel examination shows innumerable closely spaced broad-based defects (arrow) in the distal and terminal ileum. There is no obstruction. At exploration, the entire colon and most of the small bowel were diffusely infiltrated with lymphosarcoma.

Treatment was discontinued because of leukopenia, which rapidly recurred when retreatment was attempted three years later. Nitrogen mustard has also been used, but the advantages of this type of therapy over local radiotherapy, if any, are not clear. It is likely that the same precautions used in the conduct of radiotherapy should be applied if nitrogen mustard or similar chemotherapeutic agents are to be utilized.

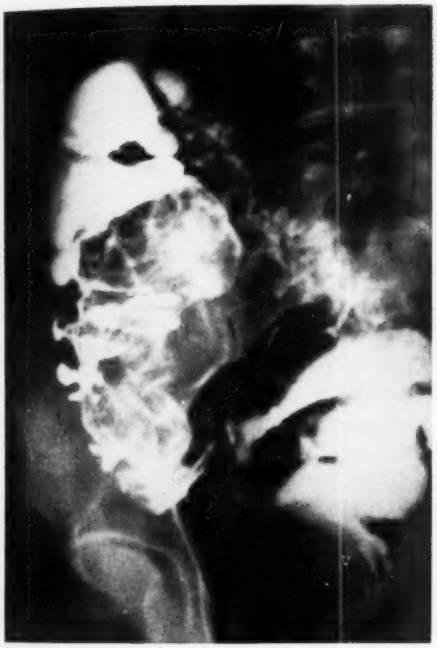

Fig. 8. Barium enema shows a huge partially intussuscepting, multilobulated mass in the ascending colon which is broad-based in the region of the ileocecal valve. The terminal ileum was not filled. At operation, a large convoluted lymphosarcomatous mass was found attached to the ileocecal valve, but the process extended for a long distance into the ileum in the form of innumerable polypoid projections

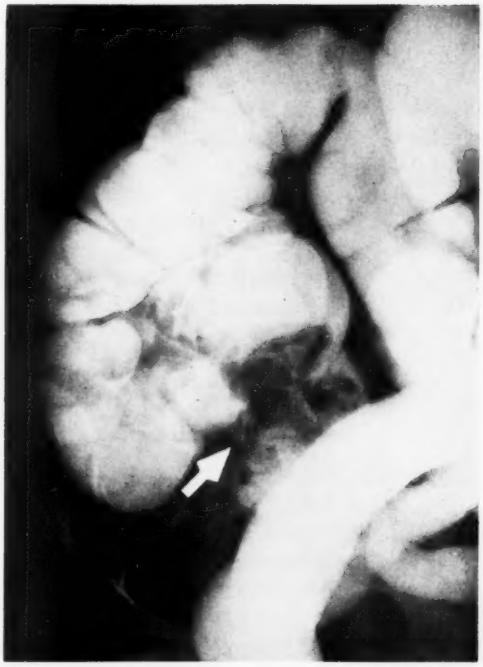

Fig. 9. Hodgkin's disease of the terminal ileum and cecum. A large, coarsely lobulated, partially intussucepting mass is present in the ileocecal region.

SUMMARY

Lymphosarcoma of the colon occurs in two main varieties—as a discrete tumor or as extensive diffuse submucosal and mucosal infiltration without remarkable involvement of the deeper layers of the bowel wall. The latter type may involve the entire colon and extend into the terminal ileum for a considerable distance.

The roentgen features of diffuse lymphosarcoma of the colon resemble those seen in the "giant rugae" type of lymphosarcoma of the stomach. There is a pronounced exaggeration of the mucosal fold pattern, combined with innumerable sessile polypoid protrusions into the lumen. In areas of maximum involvement, there may be formed a large convoluted mass, which may result in intussusception. The colon shows normal or increased distensibility despite massive infiltration of the superficial layers. Contractility of the bowel wall appears to be unaltered but cannot be complete because the redundant, thickened mucosa and submucosa fill and widen the residual lumen.

Radiotherapy must be carefully administered to patients with diffuse lymphosarcoma because systemic reactions and leukopenia may be easily induced. Relatively small doses of radiation may be

effective in inducing a satisfactory remission.

ACKNOWLEDGMENT: The authors thank Drs. Silverstone, Simon, and Greenberg for permission to use the case illustrated in Figure 5.

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SUMMARIO IN INTERLINGUA

Characteristicas Roentgenographic de Diffuse Lymphosarcoma del Colon

Lymphosarcoma del colon occurre in duo major varietates: como un tumor discrete o como un extense e diffuse infiltration submucosal e mucosal sin remarcabile alterationes in le stratos plus profunde del pariete intestinal. Iste secunde typo pote afficer le integre colon e extender se in le ileum terminal.

Le characteristicas roentgenographic in le diffuse varietate de lymphosarcoma resimila le characteristicas incontrate in le typo a "rugas gigante" de lymphosarcoma del stomacho. Es presente un pronunciate exaggeration del delineation del plicas mucosal, combinate con innumerabile sessile protrusiones polypoide in le lumine interior. In areas de affection maximal, il pote occurrer le formation de un grande massa convolute le qual resulta in intussusception. Le colon monstra normal o augmentate grados de distensibilitate in despecto del infiltration massive de su stratos superficial. Le contractilitate del parietes intestinal pare esser intacte, sed illo non pote esser complete a causa del redundante spissificate mucosa e submucosa que replena e allarga le remanente lumine.

Lymphosarcoma debe esser differentiate ab polyposis familial, ab colitis ulcerative con alterationes pseudopolypoide, e ab colitis granulomatose o ileocolitis.

In un micre numero del observate casos, le radiotherapia esseva surprendentemente efficace in le subjugation del morbo durante un restringite periodo de tempore. Le administration del radiotherapia debe esser maneate cautissimemente, proque reactiones systemic e leucopenia es facilemente inducite per illo.

Vocal Cord Paralysis: A Roentgen Diagnostic Study[1]

SOL M. UNGER, M.D., BERNARD ROSWIT, M.D., and JOSEPH STEIN, M.D.

TOMOGRAPHIC examination of the larynx in patients with vocal cord paralysis yields truly valuable diagnostic and prognostic information. Yet, we could find only five published reports dealing with the radiography of this ominous lesion (1–4, 22). Only one of these communications was from the American medical literature (2).

In this report we will deal primarily with the tomographic aspects of vocal cord paralysis secondary to involvement of the recurrent laryngeal nerve by extralaryngeal lesions, correlating the roentgen signs with the pathologic physiology. In a later report, we will discuss our tomographic experience with vocal cord dysfunction arising from direct infiltration by laryngeal carcinoma.

CLINICAL MATERIAL

Our material was obtained by correlation of clinical experience in the Radiotherapy Department with radiologic diagnosis. In all of the cases to be discussed, the roentgen findings were verified by means of indirect mirror examination, direct laryngoscopy, or bronchoscopy.

Most of our patients in the present study were suffering from carcinoma involving structures in the thorax or neck. Patients with carcinoma of the larynx were excluded.

Vocal cord paralysis was most frequently encountered in association with bronchial or esophageal cancer. Next in order of frequency were neoplasms of the neck, gastrointestinal tract, and kidney. There was only one instance of this complication associated with bladder carcinoma. Although nearly 500 patients with Hodgkin's disease have been treated in our Radiation Clinic, only 3 of these had recurrent nerve paralysis. We encountered no vocal cord lesions associated with cancer of the breast, cervix, or ovaries, probably because our practice is largely limited to male veterans. Included in this study are 1 patient with acute thyroiditis and 2 with paralysis after thyroidectomy.

Our follow-up observations in nearly all cases were continuous, but were limited to periods up to one year since death occurred early from advanced local or metastatic carcinoma.

In 3 cases the vocal cords returned to a relatively normal appearance after treatment of the primary disease—acute thyroiditis in 1 instance, Hodgkin's disease of the superior mediastinum in another, and carcinoma of the esophagus in a third (Fig. 6). The thyroiditis was managed by means of steroids, and the neoplasms were treated with beam irradiation. In the patient with Hodgkin's disease, paralysis of the contralateral vocal cord subsequently developed.

Left cord paralysis outnumbered that of the right cord by 5 to 1. Bilateral involvement was observed in 2 patients with pharyngeal carcinoma.

Two cases of partially paralyzed vocal cords were observed in patients with bronchogenic carcinoma.

ROENTGEN SIGNS AND PATHOLOGIC PHYSIOLOGY

The recurrent laryngeal nerve innervates all of the intrinsic muscles of the larynx except the cricothyroid, which is supplied by the superior laryngeal nerve. The recurrent nerve also sends filaments to the inferior constrictor muscle, which forms part of the pyriform sinus. The degree of involvement of this critical nerve

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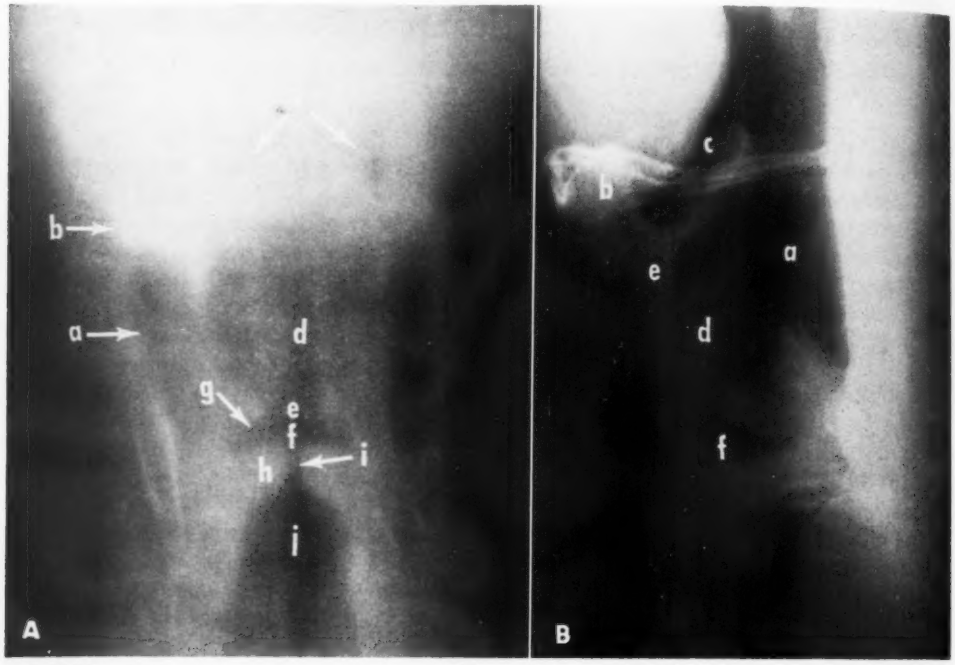

Fig. 1. A. Normal tomogram of the larynx during phonation. Note the pyriform sinus (a); hyoid bone (b); right and left valleculae (c); vestibule (d); rima vestibuli (e); ventricle (f); false vocal cord (g); true vocal cord (h); rima glottis (i); infraglottic area and trachea (j).

B. Soft-tissue lateral film of the neck, showing superimposed right and left pyriform sinuses (a); the hyoid bone (b); the valleculae (c); the vestibule (d); the epiglottis (e); the ventricle (f).

C. Normal tomogram of larynx during inspiration. The true vocal cords are abducted (h) and the glottis (i) is wide and lozenge-shaped.

governs the nature of the roentgenologic pathology.

The key to the roentgen diagnosis of recurrent laryngeal nerve paralysis lies in the recognition of the difference between tonicity and atonicity of the structures shaping the (*a*) pyriform sinus, (*b*) vestibule, (*c*) ventricle, (*d*) glottis, (*e*) the false cords, and (*f*) the true cords. The roentgen examination which can best delineate these areas is coronal tomography carried out with the patient phonating a high-pitched vowel such as "E." Such a radiograph in a normal subject is reproduced in Figure 1, A. All of the areas should be symmetrical and sharply defined because of normal structural tonicity. Each will be discussed in terms of the abnormal roentgen appearance created by its paralyzed musculature. Occasionally, a tomographic study during inspiration (Fig. 1, C) can strikingly demonstrate a fixed paralyzed vocal cord (Figs. 2, C and 3).

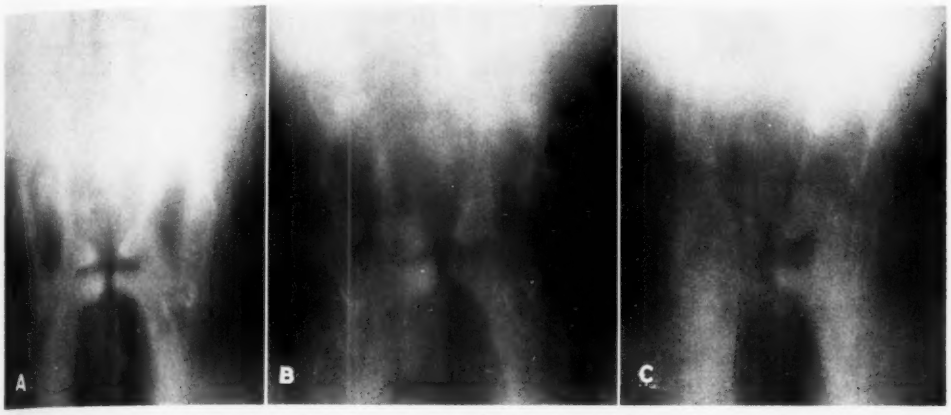

Fig. 2. A. Tomogram of the larynx in phonation, showing paralyzed left vocal cord. Note asymmetry of lower portion of vestibule, incomplete aeration of lower part of the left pyriform sinus, left-sided enlargement and irregularity of left part of the ventricle, slight displacement of the glottis to the left, with hypertrophy of the lower part of the right vocal cord. The findings are subtle but definitely diagnostic.

B. Tomogram of the larynx in phonation, taken seven months after A. The asymmetry of the lower portion of the vestibule, the nonaeration of the lower part of the left pyriform sinus, the shape of the left part of the ventricle, the displacement of the glottis to the left, and the hypertrophy of the lower part of the right vocal cord are unchanged.

C. Tomogram of the larynx in inspiration taken at the same time as B. Note enlargement of left side of the ventricle, with left vocal cord fixed in adduction, indicating paralysis. The right side of the ventricle is not visible because the right vocal cord is abducted, producing the enlarged glottic aperture and obliterating the right part of the ventricle.

(*a*) The *pyriform sinus* is a recess formed by the middle and inferior constrictor muscles, with the inferior portion made up entirely of the latter structure. Normally, the sinus is of a somewhat oval shape with the long axis in the superior-inferior position. In paralysis, the inferior constrictor muscle cannot contract. The pyriform sinus then fails to visualize in its inferior portion (Figs. 4 and 5) or, if partially filled with air, is smaller than normal (Figs. 2, A and B).

(*b*) The *vestibule* is a space bounded by the arching fibers of the arytenoideus oblique muscle. They create, inferiorly, a symmetrical narrowing leading to the rima vestibuli. In paralysis, this symmetry is lost, and the picture may be striking (Figs. 4 and 6, A), with the paralyzed side meeting the paralyzed ventricle at an acute angle. The asymmetry may sometimes be more subtle, with straightening of the lower part of the vestibule (Figs. 2, A and B, and 5).

(*c*) The *ventricle* of the larynx is a fusiform recess lying between the superior ventricular fold (false vocal cord) and the inferior ventricular fold (true vocal cord). It is lined by the thyroarytenoid muscle. When this muscle cannot contract, the ventricle on the paralyzed side is usually larger than normal and its margins become hazy (Fig. 2, A and B). It may also be triangular in outline and elevated (Fig. 4). Occasionally, it is of a somewhat oval shape with hazy margins (Fig. 5), or small and elevated (Fig. 6, A).

(*d*) The *false vocal cords* are two folds of mucous membrane, each enclosing a narrow band of fibrous tissue called the ventricular ligament. They lie on either side of the rima vestibuli and form the superior boundary of the ventricle.

(*e*) The *true vocal cords* are concerned with the production of sound and enclose two strong bands known as the vocal ligaments. Each ligament consists of a band of yellow elastic tissue attached in front to the angle of the thyroid cartilage and behind to the vocal process of the arytenoid. Its upper border forms the lower boundary of the ventricle of the larynx and the lower border is continuous with the lateral part of the conus elasticus,

Fig. 3. Tomogram of the larynx in inspiration, showing enlargement of the right side of the ventricle and paralyzed right vocal cord fixed in adduction, indicating paralysis. The left part of the ventricle is not visible because the left vocal cord is abducted, producing the enlarged glottic aperture. Note calcification of right thyroid adenoma.

which connects the front parts of the contiguous margins of the thyroid and cricoid cartilages. The conus elasticus is also called the cricothyroid membrane.

(*f*) The *glottis or rima glottis* is the elongated fissure between the true vocal folds in front and the bases and vocal processes of the arytenoid cartilages behind. The width and shape of the glottis vary with the movements of the vocal folds and arytenoid cartilages during respiration and phonation. During extreme adduction (Fig. 1, A), as in the sounding of a high note, it is reduced to a linear slit by the apposition of the vocal folds. Conversely, in extreme abduction of the vocal folds, as in forced inspiration, the arytenoids and their vocal processes are rotated laterally and the entire glottis becomes lozenge-shaped. The widest part of the aperture corresponds with the attachment of the vocal folds to the vocal processes (Fig. 1, C). The vocal cords are abducted by the posterior crico-arytenoideus and adducted by the lateral crico-arytenoideus. They are made tense by the crico-thyroideus and slackened by the thyro-arytenoideus and the vocalis.

The most constant roentgen finding in paralysis of the recurrent laryngeal nerve is a shift of the glottis from the midline toward the paralyzed side (Figs. 2, A and B; 4; 5; 6, A). The appearance depends upon the action of the thyro-arytenoideus and the vocalis muscles. The glottis is usually perpendicular, though rarely it may be angulated toward the paralyzed side because of the action of the vocalis muscle (Fig. 5). The infraglottic area usually is somewhat right-angled in appearance, due to the tonicity of the unaffected vocalis muscle, which crosses the midline to the paralyzed side (Fig. 5). In long-standing cases, no progressive increase in the degree of tonicity could be demonstrated (Fig. 2, A and B).

The routine lateral soft-tissue film of the neck (Fig. 1, B) aids in the diagnosis of paralysis only if the paralyzed part of the ventricle is elevated, when the image of a double ventricle may be seen. This, however, is not a truly reliable sign of paralysis of the vocal cords.

ROENTGEN ANATOMY

The normal tomogram during phonation shows all structures to be symmetrical and well defined by air contrast (Fig. 1, A). During inspiration (Fig. 1, C) an entirely different roentgen appearance is produced when the vocal cords are abducted as described above. Figure 2, A is a tomogram in phonation, showing paralysis of the left vocal cord of two months duration. The subtle asymmetry of the lower part of the vestibule and slight elevation of the left side of the ventricle are noteworthy. The latter is larger than the right ventricle and more hazy and irregular in outline. The glottis is slightly shifted to the left. A repeat tomogram in phonation (Fig. 2, B) taken seven months later shows

Fig. 4. Tomogram of the larynx in phonation, showing paralysis of the right vocal cord; no visualization of the lower part of the right pyriform sinus. There is asymmetry of the lower part of the vestibule, with elevation and well defined slight enlargement of the right side of the ventricle. The glottis is displaced toward the right by the hypertrophied left vocal cord.

the appearance of the left pyriform sinus, asymmetry of the vestibule, elevation of the left ventricle and right vocal cord to be unchanged. Figure 2, C is a tomogram in inspiration, demonstrating the paralyzed, fixed left vocal cord. In this study, the normal right cord is partially abducted, eliminating the normal glottic configuration, while the paralyzed left vocal cord remains in adduction. In comparison, Figure 3 is a tomogram taken in inspiration, with the right vocal cord paralyzed and fixed in adduction. The left vocal cord, which is normal and mobile, is completely abducted.

When paralysis of a vocal cord is caused by a malignant process, one rarely notes return of the voice to normal after treatment of the neoplasm. Figure 6, A shows slight hypertrophy of the right vocal cord with slight displacement of the glottis to

Fig. 5. Tomogram of the larynx in phonation, showing paralysis of the left vocal cord. The inferior part of the left pyriform sinus is not aerated, the vestibule is asymmetrical, and the left side of the ventricle is slightly irregular and elevated. The glottis is displaced toward the left, and the right vocal cord is hypertrophied.

the left, elevation of a small left ventricle, and a mass along the left margin of the vestibule. This patient had a large epidermoid carcinoma along the left posterior part of the hypopharyngeal wall, extending to the upper third of the esophagus. Direct laryngoscopy showed left vocal cord paralysis. Radiation therapy was given to the hypopharynx and upper third of the esophagus from July 15 to Aug. 22, 1958, for a tumor dose of 5,800 r. Eleven months later (Fig. 6, B) vocal cord paralysis had practically disappeared. The tomogram shows the glottis in the midline, no hypertrophy of the right vocal cord, a slight irregularity of the left part of the ventricle, and poor aeration of the left pyriform fossa. This is one of the rare instances where recovery of nerve function followed radiation therapy.

Two patients with bronchogenic carcinoma had complete paralysis of the left vocal cord prior to irradiation. After the administration of 3,500 r and 4,000 r, respectively, to the superior mediastinum, partial recovery of function was noted. This was documented by clinical observation and tomograms.

A patient with mediastinal Hodgkin's disease had paralysis of the left vocal cord, proved by indirect mirror examination and

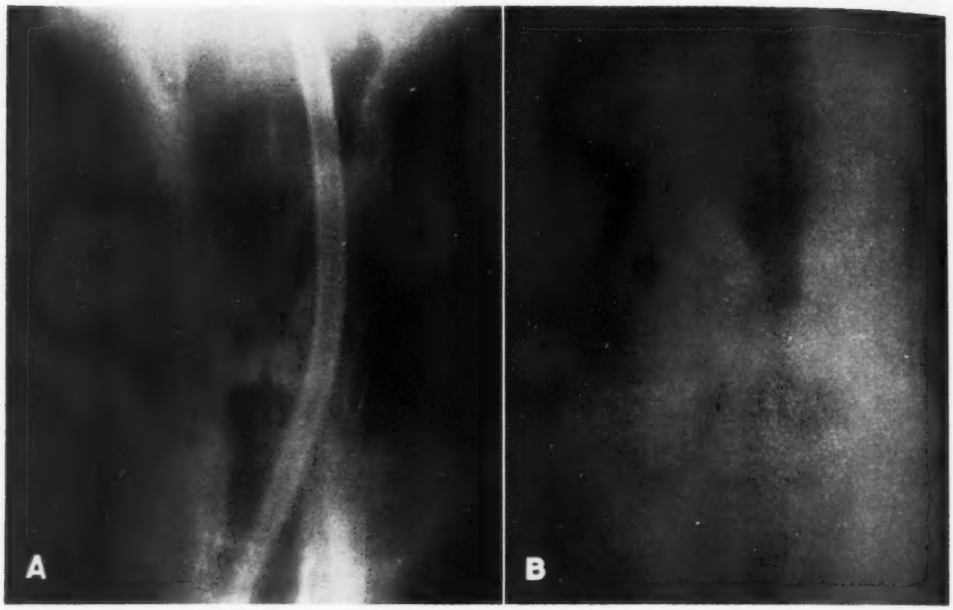

Fig. 6. A. Tomogram of the larynx in phonation, showing paralysis of the left vocal cord. A large mass can be seen along the left posterior hypopharyngeal wall, encroaching upon the vestibule. Neither pyriform sinus is visualized. The lower part of the vestibule is asymmetrical, the left side of the ventricle is small and elevated, the glottis is displaced toward the left, and there is slight hypertrophy of the right vocal cord. Note also the Levine tube.

B. Tomogram of the larynx in phonation, taken eleven months after A. The Levine tube has been removed. The left posterior hypopharyngeal mass cannot be seen. The left pyriform sinus is poorly aerated, the lower part of the vestibule is still asymmetrical, the ventricle is aerated with some irregularity of the left side, the glottis is in the midline, and there is no hypertrophy of the right vocal cord. The fibers of the left recurrent laryngeal nerve have partially regained normal function.

tomograms. After delivery of 2,600 r to the superior mediastinum in thirty-five days, the paralysis disappeared. Two years later, with disseminated Hodgkin's disease, the left vocal cord was still normal, but there was now paralysis of the right vocal cord.

SUMMARY AND CONCLUSION

1. Tomographic examination of the larynx in patients suspected of paralysis of the recurrent laryngeal nerve is a valuable diagnostic and prognostic tool which has only rarely been described in the medical literature.

2. The anatomy, function, and tomographic appearance of the normal laryngeal structures have been reviewed.

3. Representative cases of vocal cord paralysis have been presented from the authors' experience, correlating the roentgen pathology with the anatomical and functional abnormalities produced by the disease.

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SUMMARIO IN INTERLINGUA

Paralyse del Cordas Vocal: Un Signo Roentgenodiagnostic

Le clave al roentgenodiagnose de paralyse del recurrente nervo laryngeal se trova in le recognition del differentia inter tonicitate e atonicitate del structuras que forma le sino pyriforme, le vestibulo, le ventriculo, le glottis, le cordas vocal superior, e le cordas vocal inferior. Le examine roentgenologic que es le melio capace a delinear iste areas es tomographia coronal effectuate durante le phonation de un vocal de alte diapason, como per exemplo le vocal "I". Normalmente iste areas es symmetric e nettemente definite. In le presentia de paralyse, le imagine es differente, e symmetria es reimplaciate per asymmetria. Le plus constante constatation roentgenologic es un displaciamento del glottis verso le latere paralysate. In certe casos il es possibile demonstrar un fixe corda vocal paralysate per medio de un tomogramma obtenite durante le inspiration.

Dumbbell Bronchogenic Cysts[1]

ELLIOTT C. LASSER, M.D.

TWO CASES OF dumbbell bronchogenic cysts, similar in gross morphology and general location, have been encountered by the author in the past five years. These unusual-appearing cysts are thought to be of developmental origin and would appear to fall somewhere in between simple single bronchogenic cysts and so-called congenital cystic bronchiectasis or honeycomb lung. The first case comes from Roswell Park Memorial Institute and is presented here with the kind permission of Dr. Franz Lessman, who is Director of Diagnostic Radiology at that institution. The second case, which was roentgenographically so similar to the first that a tentative preoperative diagnosis could be advanced, was seen in the Department of Radiology of the Pittsburgh Woman's Hospital.

CASE REPORTS

CASE I: F. M. (Roswell Park Memorial Institute), a 34-year-old white male without symptoms, showed an abnormal shadow on a routine survey film of the chest (Fig. 1). Physical examination disclosed no significant abnormality. Thoracotomy was carried out purely on the basis of the roentgenographic demonstration of two closely situated pulmonary nodules of undetermined origin.

When the right thorax was opened, a smooth-walled cyst was found, which appeared to be in the fissure between the upper posterior segment and the superior segment of the lower lobe. Further dissection showed the cyst to be entirely within the substance of the posterior segment of the upper lobe. On exploration it proved to be in reality a multiple ramifying cyst consisting of a larger and smaller cystic collection with an intervening communication. It contained a thick, gray mucoid material. The walls were thin and there was no sign of infection. Although the cyst resembled a bronchial tree, there was no evidence of communication with the normal tracheobronchial arborization. There were no associated abnormal vessels, and segmental resection was carried out.

Pathological Report: The specimen was an 8 × 7 × 4-cm. pyramidal segment of lung partly covered by pleura. Along one resected surface was the previously opened collapsed cyst estimated to have been approximately 2 cm. in its greatest dimension. It had a thin fibrous wall which was irregularly folded. Histologically this contained cartilage plates, smooth muscle bundles, and small groups of bronchial glands. Most of the lining epithelium was missing, but in a small crypt some respiratory epithelium was evident.

CASE II: M.P. (Pittsburgh Woman's Hospital), a 44-year-old white female, was seen by her local physician shortly before admission because of hot flashes. On physical examination, a unilateral wheeze was heard over the right lower chest and a roentgenogram showed a density in the right lung. The patient was thereupon sent to Woman's Hospital for evaluation and treatment. On physical examination, the only abnormality noted was an acute inflammation of lymphoid tissue in the right tonsillar fossa, with tender nodes in the right side of the neck. This was found to be an incidental acute pharyngitis.

Roentgenographic studies of the chest included films in postero-anterior and lateral projections, kymography, and bronchography. The significant findings are shown in Figure 2. On completion of these studies, it was concluded that there were two soft-tissue masses in the right lower lobe, with occlusion of the lateral basilar segmental bronchus and distortion of the medial segmental bronchus, leading to obstructive emphysema of the affected segments. The possibility that these represented congenital anomalies of the bronchi, such as bronchogenic cysts, was thought most likely. It was believed to be less probable that they might represent two bronchial adenomas or, even less likely, enlarged lymph nodes. Bronchoscopy showed a 30 per cent narrowing of the right intermediate stem bronchus with chronic inflammatory changes in the mucosa and a moderate amount of secretion. On exploratory thoracotomy it was noted that the major and minor fissures were underdeveloped. The right middle and lower lobes were resected.

Pathological Report: The specimen was a 16 × 14 × 13 cm. segment of lung in which the minor fissure was represented by two shallow grooves. An unusual polypoid lobule of emphysematous lung tissue was continuous with the midlateral portion of the diaphragmatic aspect of the lower lobe. The middle and lower lobe bronchi and their segmental branches were all identified and showed no changes except for slight fusiform dilatation of the lateral basal branch at its origin. The multi-

[1] From the Department of Radiology, University of Pittsburgh School of Medicine, and the Radiology Department, Presbyterian, Woman's, and Eye & Ear Hospitals, Pittsburgh, Penna. Accepted for publication in March 1960.

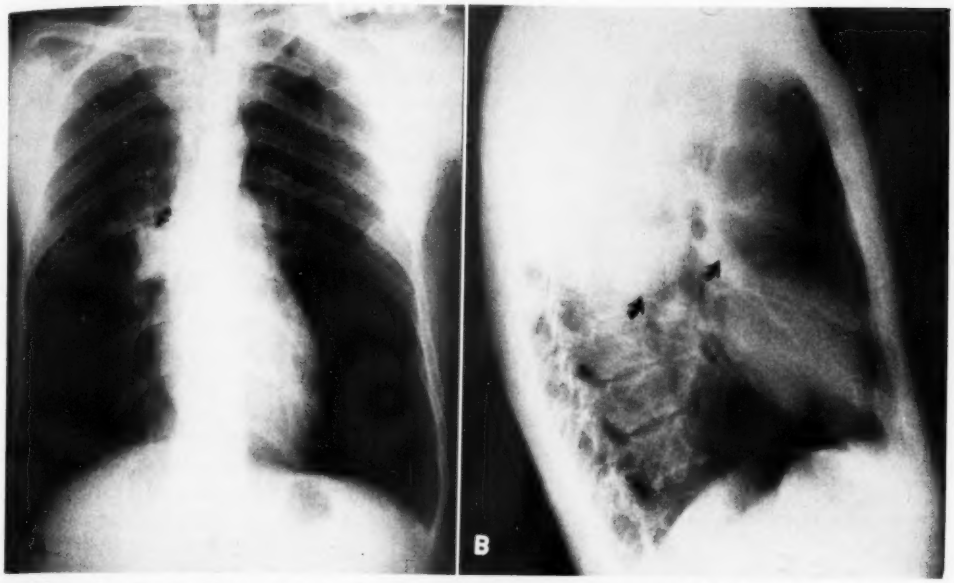

Fig. 1. Case I. A. Postero-anterior chest film showing two well demarcated nodules at the hilar level.
B. Lateral chest film showing sharply delineated masses to better advantage.

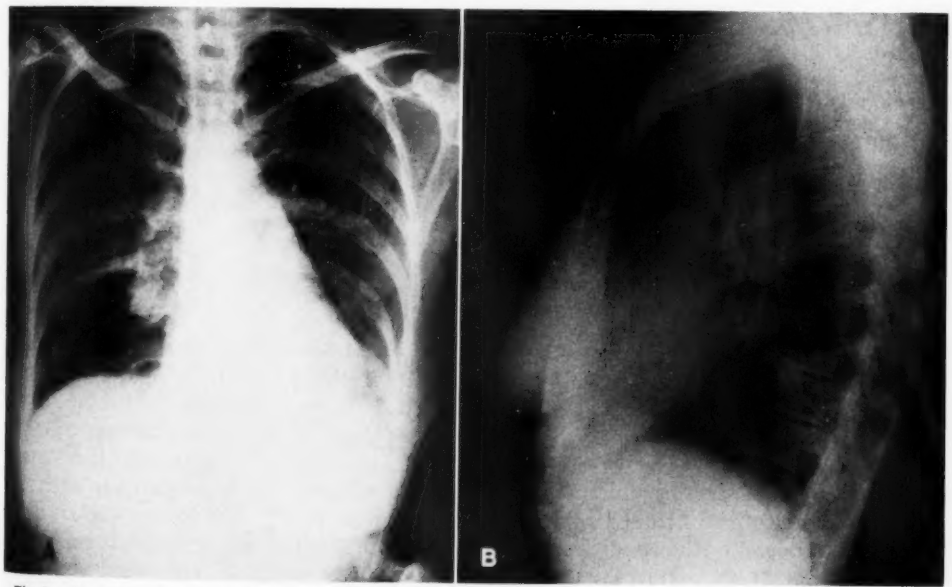

Fig. 2. Case II. Two well delineated masses partially superimposed upon each other. The right basilar segment is emphysematous.
B. Lateral chest film, of aid in separation of two soft-tissue masses. Communicating channel not visualized.

loculated cyst lay medial to the medial basal bronchus, extending to within 0.5 cm. of the pleural surface. The principal portion of the cyst was roughly dumbbell-shaped. The upper globular cavity, 3.5 cm. in diameter, communicated with the lower 1.8-cm. ovoid cavity by a short tube 0.3 cm. in diameter (Fig. 3). Just above this communication was the opening into a third small sac, 0.8 cm.

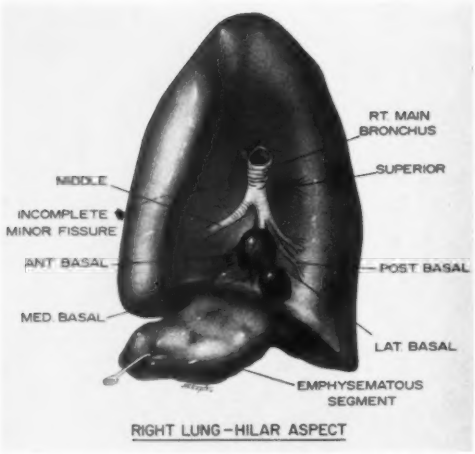

Fig. 3. Case II. Artist's conception of right lung with dumbbell cysts, as reconstructed from surgical report and resected specimen.

deep and 0.2 cm. in diameter. No bronchial communication was demonstrated. The cysts had a continuous thin wall and were filled with yellowish-tan mucoid material. They were lined by a smooth, slightly trabeculated, pinkish-tan membrane. Both the medial and lateral basilar bronchi were somewhat stretched over the cystic mass but neither showed dilatation distally. No bronchus was grossly identified passing into the emphysematous segment. Both the pleural and sectioned surfaces of this lobule were pinkish-tan and showed little evidence of anthracosis as compared to the remainder of the specimen.

Histologically the cysts were lined by flattened respiratory epithelium with a prominent hyalinized basement membrane. The thin, fibrous wall contained neither cartilage nor glands, but in several areas bundles of smooth muscle were evident. The emphysematous segment contained widely scattered, small bronchioles. Microscopic deposits of anthracotic pigment were identified.

DISCUSSION

There is a rather striking similarity in the roentgen presentation of these two developmental bronchogenic abnormalities. In the first case, the cyst lay within the lower portion of the posterior segment of the right upper lobe, adjacent to the fissure between the upper and lower lobes. In the second case, the site was at a slightly lower level, 2.5 cm. below the orifice of the lower lobe bronchus. Roentgenographically, each cyst appeared as two separate, well outlined, homogeneous adjacent pulmonary nodules. The location of the nodules and their sharply circumscribed nature and somewhat angular shape suggested that they probably did not represent enlarged parabronchial nodes. In neither instance was the communicating channel thoroughly distinguishable. In the first case, there were no associated parenchymal abnormalities; in the second, there was an emphysematous lobe practically devoid of anthracotic pigmentation, attesting to the long-standing compression of the bronchus leading to this segment, plus some congenital abnormalities of pleural segmentation.

Boyden (1), in his extensive studies of developmental anomalies of the lungs, notes that "the etiology of cystic diseases of the lungs is one upon which few investigators agree. Embryologically, there is little evidence, if any, supporting an early separation or constriction of portions of the developing bronchial tree. That such may occur in late fetal stages or at birth through pathologic processes or otherwise seems more probable." Boyden further points out that cystic disease is often associated with the presence of a large accessory pulmonary artery arising from the lower thoracic aorta or even from lower intercostal or subdiaphragmatic arteries. In common with others (2), he doubts that there is much merit to the suggestion, often made, that the terminal buds of the growing bronchial tree have been captured by systemic arteries that anchor the mass while the lung is undergoing developmental shift. Accessory arteries to the base of the lungs may occur in the absence of cysts, and so-called sequestrated lungs may exist without an accompanying accessory artery. Fry (2) and his co-workers agree that when an artery is found in relation to an area of so-called pulmonary sequestration, the relationship is purely passive; that is to say, the artery is in fact a nutrient vessel to the sequestrated mass.

One may indeed speculate on the relationship of so-called pulmonary sequestration to the cases in this report; particularly the second case, in which, in addition to the

branched cyst, there was an associated nonpigmented emphysematous lobe (3). In any event, it is clear that in the normal course of development of the lung, growth of new bronchopulmonary elements continues until the seventh or eighth year or, in some instances, as late as the fourteenth year. Baxter and Meakins (4) point out that cystic disease of the bronchopulmonary tree could thus develop at any time during this period.

It is our feeling that there is little to be gained here by further speculation on the origin of these branched bronchogenic abnormalities. It is hoped merely that the roentgen characteristics of this developmental abnormality may be borne in mind and added to the list of differential considerations of multiple parahilar nodules.

CONCLUSION

Two cases of unusual branched bronchogenic cysts have been reported, with similar roentgen characteristics. No attempt is made to pinpoint the precise developmental origin of these anomalous cysts or to classify them exactly. Reports of similar abnormalities may help in this respect.

NOTE: The author wishes to express his gratitude to Dr. Robert S. Totten, who reviewed and summarized the pathological findings and to Mr. Stephen M. Shapiro, who prepared the illustration of the gross findings in Case II. This latter case is presented with the kind permission of Dr. William B. Ford, who performed the surgery.

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SUMMARIO IN INTERLINGUA

Cystes Bronchogene de Roentgeno-Apparentia Bi-Nodulate

Es reportate duo casos de inusual brancate cystes bronchogene con simile characteristicas roentgenographic. In un del casos, le cyste jaceva intra le portion inferior del segmento posterior del lobo dextero-superior, adjacente al fissura inter isto e le segmento supero-posterior del lobo inferior. In le altere caso le nivello del sito esseva levemente plus basse, 2,5 cm infra le orificio del broncho del lobo inferior. In ambe casos le configuration roentgenologic presentava duo separate, ben delineate nodulos homogenee con un communication indistinctemente delineate. Es facite nulle tentativa de establir precisemente le origine disveloppamental de iste cystes o de classificar los exactemente. Il pare plausibile considerar los como intermediari in le un o le altere senso inter simple, unic cystes bronchogene e le si-appellate bronchiectasis cystic o pulmon faveolate.

Noninfectious Necrotizing Granulomatosis: The Pulmonary Roentgen Signs[1]

MARTIN E. BISCHOFF, M.D.

RECENTLY we have been stimulated to peruse the literature concerning Wegener's granulomatosis and periarteritis nodosa, the stimulus being provided by the circumstance of seeing examples in the brief span of six months. The cases with roentgen findings which have been reported number approximately 25. From these, a pattern of pulmonary roentgen shadows consisting of nodular and infiltrative densities seems to emerge. It is the purpose of this article to add to the knowledge concerning these radiologic signs.

DESCRIPTIVE PROFILE

Felson and Braunstein (5) coined the term "noninfectious necrotizing granulomatosis" to embrace several entities which appear to be related. Among these are Wegener's granulomatosis, Churg and Strauss' granulomatosis, midline lethal granuloma, allergic or hypersensitivity angiitis, and pulmonary granulomatosis. The relationship of periarteritis nodosa to this group is a matter of controversy. Histologically the necrotizing angiitis of periarteritis nodosa is quite similar to the angiitis of necrotizing granulomatosis. There is evidence, therefore, for the assumption that periarteritis nodosa is merely a manifestation of the vascular component of necrotizing granulomatosis without the formation of aseptic granulomas.

It is proper that the pathologists continue to strive to resolve the problems of proper classification, etiology, and pathogenesis. For the purpose of the radiologist, who is attempting to recognize the pulmonary roentgen signs, it is well to consider all of the entities as manifestations of a single disease process.

To elaborate further, these disorders have in common a histologic response characterized by aseptic granulomas and necrotizing inflammation of the arteries and veins. The changes are compatible with a hypersensitivity reaction such as has been produced experimentally in animals. Evidence has accumulated to support speculation that the etiologic factor in man is an allergy (1, 2).

The granulomas vary in size from a few millimeters to more than 5 cm. in diameter. They are surrounded by inflammatory cells and have friable and necrotic centers. Eosinophilia may be a prominent feature. The vascular alterations consist in localized fibrinoid necrosis followed by inflammatory reaction.

The organ system primarily affected gives rise to the clinical manifestations. Most prominent are necrotizing granulomas of the respiratory tract, generalized angiitis, and necrotizing glomerulitis (2, 4).

A disease pattern begins to evolve. The diagnosis depends on evaluation of an allergic history, destructive granulomas of facial and respiratory structures, granulomas of the skin, eosinophilia, renal disease, and roentgen signs. With the exception of those cases which show only the hypersensitivity angiitis, noninfectious necrotizing granulomatosis has invariably terminated fatally after months or several years.

PULMONARY ROENTGEN SIGNS

The signs and symptoms of pulmonary involvement by noninfectious necrotizing granulomatosis are chest pain, cough, hemoptysis, night sweats, and dyspnea. Asthmatic episodes occur. Roentgen changes may or may not be observed but, when present, may represent a myriad of pathologic processes. These have been well summarized by Felson and Braunstein and may be loosely classified as non-

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Fig. A. Case I. A1. Nodular and infiltrative densities are present throughout the lungs, with superimposed congestion, edema, and bronchopneumonia.
A2. Three months later the densities from cardiac decompensation and pneumonia have cleared. The nodular and infiltrative densities are more apparent.

specific and specific. Nonspecific changes are due to bronchopneumonia, congestion and edema, and pulmonary infarction. The specific changes are caused by the granulomas and the necrosing lesions in the vessels. These are seen as single or multiple nodules and infiltrates which are chronic and may or may not have central cavitation (7). They are most likely to be confused with alterations arising from metastatic neoplasm, infectious granulomatosis, or a fibrosing process.

Four cases will be added to the literature in the hope of increasing the awareness and knowledge of the roentgen signs as manifested by the chest.

CASE REPORTS

CASE I: A white man sixty-five years of age had been hospitalized six times in one and one-half years for cardiac decompensation and intermittent episodes of jaundice. The final admission to Saint Luke's Hospital was on Aug. 12, 1955. The patient was then suffering from cardiac decompensation, mild jaundice, and right parasternal chest pain.

X-ray examinations of the chest had been made at intervals. The first (Fig. A1), May 18, 1955, demonstrated an enlarged heart with edema and effusion. An area of infiltration suggested bronchopneumonia. Underlying these changes were diffuse densities of nodular and infiltrative character. An admission roentgenogram of the chest (Fig. A2) was obtained on Aug. 12. This film clearly demonstrated diffuse nodular and infiltrative densities throughout both lungs.

Urinalysis on Aug. 13 revealed occasional red blood cells and 0 to 2 white blood cells per high-power field. The white blood cell count was 16,050, with 84 segmented polymorphonuclear cells, 3 band cells, and 13 lymphocytes.

On Aug. 18, the patient died. The gross autopsy findings included rheumatic heart disease with mitral and aortic stenosis and aortic insufficiency. There were pericardial and pleural adhesions, hydrothorax, and cardiac cirrhosis. Microscopically, necrotizing angiitis was generalized in the gastrointestinal tract, lungs, gallbladder, spleen, and kidneys. The vascular changes were most severe in the lungs and were described as characteristic of periarteritis nodosa.

As the lungs are an unusual site for advanced periarteritis nodosa, it was postulated that the way had been prepared by mitral stenosis and secondary pulmonary hypertension.

CASE II: A 19-year-old white boy was admitted to Saint Luke's Hospital Dec. 5, 1958. His illness had begun three weeks earlier with the "flu," which was followed by a cough productive of dark brown sputum. He reported episodes of ankle swelling.

Physical examination revealed slight inflammation of the pharynx. Breath sounds were slightly decreased over the posterior upper lobe of the right lung, and this area was dull to percussion. Ankle edema was not present.

Roentgenograms of the chest (Fig. B1) showed an excavating lesion in the apical segment of the right lung. Another large round density was faintly demonstrated posteriorly (Fig. B2).

Bronchoscopy revealed blood-tinged secretions

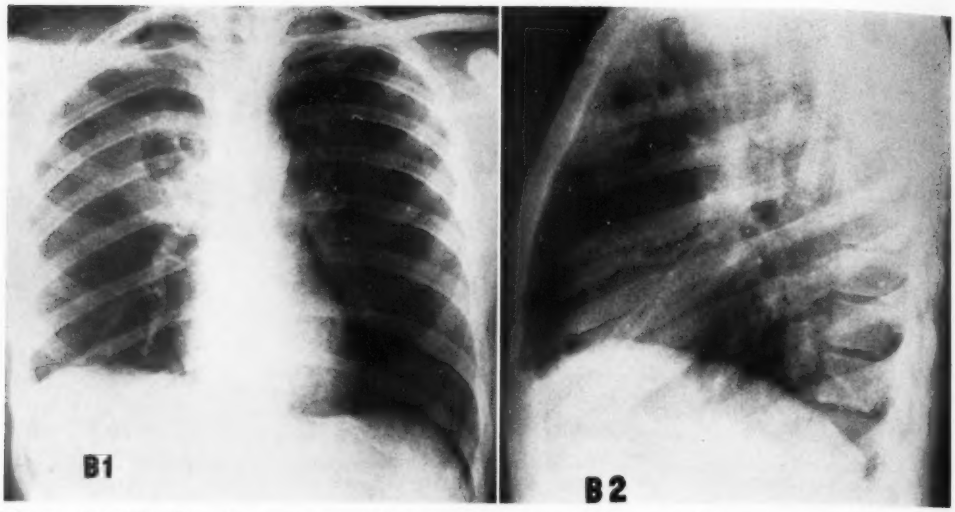

Fig. B. Case II. There is a large excavating granuloma in the right lung with a smaller granuloma lying posteriorly. The lateral view has been retouched for emphasis.

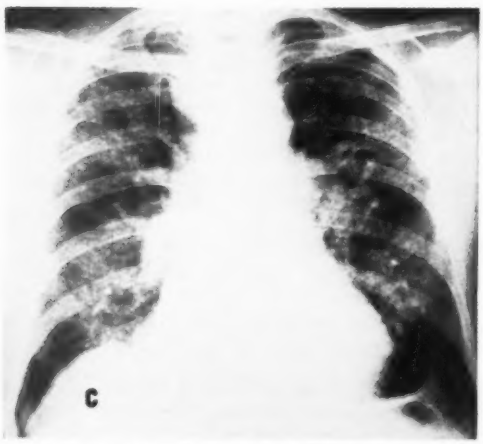

Fig. C. Case III. Nodular and infiltrative densities are present throughout the lungs.

coming from the right upper lobe bronchus. Papanicolaou smears of the secretions were negative and no pathogenic organisms could be cultured. Skin testing for tuberculosis, histoplasmosis, and coccidioidomycosis was negative.

The white blood count was 14,700, with 75 segmented cells, 1 band cell, 14 lymphocytes, 2 monocytes, and 8 eosinophils. Urinalysis revealed 15 to 20 red blood cells and 10 to 12 white blood cells per high-power field.

Cough, fatigue, and fever became persistent. On the thirteenth hospital day, a right upper lobectomy was performed. Histologic diagnosis was a necrotizing granulomatous lesion, etiology undetermined.

Recovery from surgery was uneventful, and the boy was discharged from the hospital. Subsequently, during hospitalization elsewhere, a rash developed over his entire body. This was associated with purpuric lesions on both lower extremities extending to the hips. Biopsies of the skin lesions were interpreted as acute vesicular necrotizing dermatitis.

Death occurred March 28, 1959. A postmortem biopsy of the kidney disclosed acute focal necrotizing glomerulitis.

The clinical manifestations and histologic findings were consistent with a diagnosis of Wegener's granulomatosis.

CASE III: A 65-year-old white male was admitted to Saint Luke's Hospital April 23, 1959. His illness had begun two months previously with ankle edema, shortness of breath, and circumoral cyanosis. A chronic cough was productive of clear sputum. Weight loss of 6 pounds had occurred. Antibiotics, a digitalis preparation, and a diuretic had been prescribed.

The patient was an obese man with a loose cough and circumoral cyanosis. His pharynx was red and slightly dry. His heart was enlarged to the left.

An admission urinalysis showed 0 to 2 red blood cells, 1 to 3 white blood cells, 2 to 5 hyaline casts, and 2 to 5 epithelial cells per high-power field. The hematocrit was elevated to 54 per cent.

Roentgenograms of the chest taken at intervals during the two months of the patient's illness demonstrated consistent changes. Figure C is representative and shows the chronic, generalized nodular and infiltrative densities throughout both lungs.

On the second hospital day a lung biopsy was obtained. The tissue was cultured for organisms and none were found. Histologically, the diagnosis was pulmonary granulomatosis.

On the fifth day of hospitalization, the patient suddenly died. Autopsy revealed cor pulmonale and recent myocardial infarction. The granulomatous lesions in the lungs were described as consistent with Wegener's disease, even though other organs such as the kidney and spleen were not involved.

CASE IV: A 47-year-old white man was admitted to Saint Luke's Hospital, June 16, 1959, complaining of severe pain in the left eye. Difficulty with the eye had been chronic for one year. Treatment with steroids and antibiotics had been unsuccessful. Biopsy on May 27, 1959, revealed only chronic inflammation of the cornea.

The patient gave a history of repeated "sore throat" and "sinus trouble." Anorexia and weight loss had been present for one month. An episode of joint pain had occurred one year previously.

Physical examination revealed a corneal ulcer involving the left nasal limbus. The ulcer was covered by a conjunctival flap. The pharynx was slightly reddened.

A urine specimen contained innumerable red blood cells and 5 to 10 white blood cells per high-power field. The white blood count was 15,500, with 65 segmented polymorphonuclear cells, 16 lymphocytes, 11 monocytes, 7 eosinophils, and 1 basophil. Pathogenic organisms were not identified by skin testing and numerous laboratory procedures.

An admission roentgenogram showed generalized nodular and infiltrative densities throughout the lungs. Five days later the patient began complaining of pleuritic pain in the right lower chest. This was accompanied by severe joint pain in the left hand. X-ray examination of the hand was negative.

Bronchoscopy was done, with normal findings. On the thirteenth hospital day a right upper lobectomy was performed. The histologic appearance was that of a granulomatous process overshadowing rare involvement of small vessels by an inflammatory reaction. These changes, considered with the clinical manifestations of corneal ulceration, joint pain, and hematuria, were diagnosed as Wegener's granulomatosis.

Treatment with steroids was resumed and the corneal ulcer improved. A roentgenogram of the chest (Fig. D1) made postoperatively showed evidence of advance of the disease process. The patient was discharged to the care of his local physician.

A stormy course ensued during which cortisone and ACTH caused exacerbation of a bleeding duodenal ulcer. Denial of steroids with aggressive treatment of the ulcer led to exacerbation of the Wegener's syndrome. At last a balance was reached in which the ulcer remained asymptomatic and the granulomatous process seemed in remission.

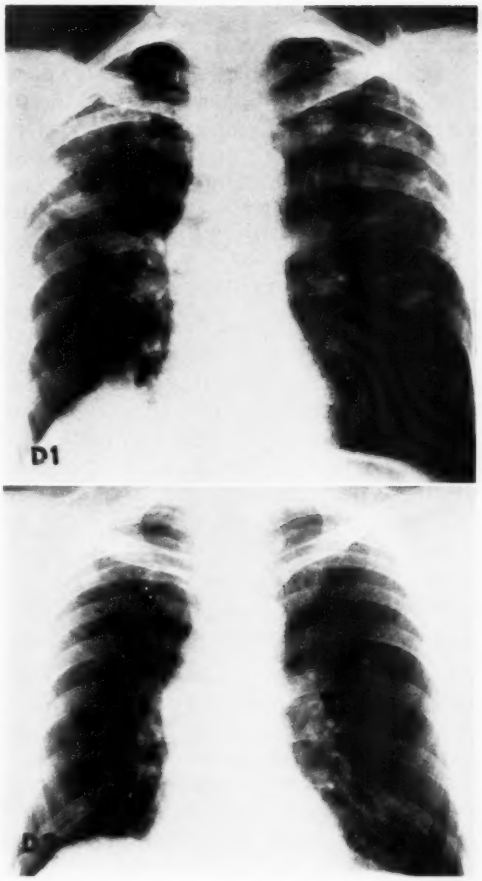

Fig. D. Case IV. D1. Thirteen days after admission and following a right upper lobectomy, the disease has progressed.

D2. Six months later the parenchymal densities have cleared after therapy with steroids. The right side of the mediastinum has widened and appears lobulated. This suggests lymphadenopathy, an unusual manifestation of Wegener's granulomatosis.

This was achieved with a maintenance dose of Decadron.

When last seen on Jan. 5, 1960, the patient was working, feeling quite well, and gaining weight. A chest roentgenogram (Fig. D2) showed clearing of the parenchymal densities. However, the right side of the mediastinum had a lobulated appearance. This suggested lymph-node enlargement, an unusual manifestation of Wegener's granulomatosis.

COMMENT

Interesting observations may be made in Cases I and IV. The finding of advanced pulmonary disease due to periarteritis

nodosa is unusual but can occur when pulmonary hypertension is present. Boyd (2) refers to Braunstein's 6 cases of which 3 had increased pulmonary pressure due to mitral stenosis. Lymphadenopathy has been rarely described as a manifestation of noninfectious necrotizing granulomatosis. Felson (5) recorded 1 case and referred to another reported by Churg and Strauss.

CONCLUSIONS

The 4 cases presented in this paper serve to emphasize some of the salient features of noninfectious necrotizing granulomatosis. The pulmonary roentgen signs, as defined previously in the literature, are again described in the hope of increasing the incidence of recognition. Of extreme importance is the proper evaluation of these signs in the light of clinical manifestations. This disease will be diagnosed more often if the radiographic interpretation is augmented by an evaluation for evidence of an allergic history, facial lesions, respiratory tract disease, renal disease, skin changes, and eosinophilia.

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SUMMARIO IN INTERLINGUA

Non-Infectiose Granulomatosis Necrotisante: Le Signos Roentgenologic Pulmonar

Es presentate quatro casos de non-infectiose granulomatosis necrotisante (granilomatosis de Wegener, granulomatosis de Churg e Strauss, granuloma centroletal, angiitis allergic o hyperesthetic, granulomatosis pulmonar) con le objectivo de signalar certes del characteristicas prominente de iste morbo. Signos roentgenographic pote sed non debe esser observate, e quando illos es presente, illos representa un legion de processos pathologic. Alterationes non-specific es le resultato de bronchopneumonia, congestion, e edema, e infarcimento pulmonar. Alterationes specific es causate per le granulomas e le lesiones necrotisante in le vasos. Istos es visualisate como nodulos isolate o multiple e como infiltratos que es chronic e que pote sed non debe haber un cavitation central. Illos es confundite le plus facilemente con alterationes que resulta de un neoplasma metastatic, de granulomatosis infectiose, o de un processo fibrotic.

Le correcte evalutation del signos roentgenographic es de grande importantia. Le morbo essera diagnosticate plus frequentemente si le interpretation radiographic es supplementate per un evaluation del possibile rolo de un historia de allergia, de lesiones facial, de morbo del vias respiratori, de morbo renal, de manifestationes cutanee, e de eosinophilia.

Achalasia of the Ureter[1]

EARL BUDIN, M.D.[2] and MAX EICHWALD, M.D.[3]

THE OBSERVATION of 6 patients with minimal degrees of achalasia of the ureter prompted our present review of the subject. This form of megaloureter, resulting from a neurogenic dysfunction of the terminal ureter, is far less clearly recognized and understood than the comparable entities of achalasia of the esophagus, colon, and bladder, even though it is probably of more common occurrence. Radiologists in particular should be quite familiar with the disorder because of the fact that the lesions of minimal severity are often asymptomatic and are first diagnosed as incidental findings in urographic examinations. But clinicians should also be alert to its occurrence, because of the varied symptoms which may be manifest.

There is a paucity of reports in the medical literature on achalasia of the ureter *per se*, and much confusion with ureteral dilatation secondary to achalasia of the bladder with reflux. Many discussions of megalobladder have appeared since Swenson's proposal that this might be the result of a congenital deficiency of parasympathetic innervation with consequent failure of relaxation of the bladder sphincters. On the subject of achalasia involving only the ureter, however, we could find no articles in the radiologic literature. And nearly all authors describing ureteral achalasia refer to cases of considerable severity, with symptoms. We should like to emphasize, on the other hand, the minimal lesions, which are probably more common. Although disagreement and confusion persist in regard to the etiology and mechanism of megaloureter due to achalasia, we believe that correlation of the urologic and radiologic findings clearly establishes the syndrome to be described.

[1] Accepted for publication in April 1960.
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[3] Encino Hospital, Encino, Calif.

CLASSIFICATION OF MEGALOURETER

Megaloureter, congenital megaureter, and hydroureter are all nonspecific terms used to describe dilated ureters of various etiology. In many cases the particular mechanism of the dilatation cannot be elucidated, but three broad categories are distinguishable:

(*a*) Mechanical obstruction, due to vessels, bands, valves, membranes, and stenoses, has been described. Also to be included in this, the largest category, are obstructions distal to the ureter, namely, in the bladder and urethra, with resulting incompetence of the ureterovesical sphincter.

(*b*) Chronic infection has been observed to cause dilatation in various parts of the urinary tract, the precise mechanism being unknown.

(*c*) Under neurogenic dysfunction, two distinct groups can be included, namely, achalasia and its opposite, incompetence of the ureterovesical sphincter with urinary reflux. It is doubtful whether a third group, primary atony of the ureter (1) exists, although reference has been made to it (2).

Achalasia can apparently be acquired as well as congenital, since ureteral dilatation is known to develop in patients with spinal cord injury with previously normal upper urinary tracts, despite their being placed on open bladder drainage from the day of injury, thus obviating the possibility of reflux (3). This report will deal only with congenital achalasia of the ureter.

INCIDENCE OF ACHALASIA

Although the urologic literature contains only a small number of cases and makes frequent note of the rarity of this condition, there is some ground for the opinion that it is not at all uncommon. Our 6 cases were all discovered during a one-year period in the radiology departments of a single large hospital and a medical clinic. One group

of urologists, Lewis and Kimbrough (4, 5), have reported 16 cases and have personally seen others. Several authors have published smaller series in children (6–8). Most of the other reports have been on individual cases, the earliest in 1925 (9), but there are references, such as that by Boeminghaus (10), to larger groups, and it would appear that a clear understanding of the entity greatly facilitates the diagnosis.

REVIEW OF THE LITERATURE

In 1923, Caulk (11) first used the term primary megaloureter to refer to dilated ureters without mechanical obstruction. Unfortunately considerable confusion in nomenclature and etiology has since entered the medical literature, so that this name no longer has much significance. Hurst and Gaymer Jones (12), in 1931, were the first to apply the term achalasia to the neurogenic disorder occurring in the terminal ureter, corresponding to Sir Cooper Perry's use of the designation for a similar condition in the esophagus. This would appear to be the preferable name, being most descriptive of the mechanism.

Since the publication of these two papers, many discussions of non-obstructive ureteral dilatations have appeared, with varying phraseology, from megaloureter, primary and secondary, to idiopathic segmental dilatation (13) and aperistaltic megaureter (14). Most of these are disorders other than achalasia and usually the etiology is undetermined. Only a few authors have used the term achalasia (1, 4, 5, 10, 12, 15), and their descriptions indicate clearly that this is indeed the condition with which they are dealing. Swenson, who probably first discussed the existence of an aganglionic disorder of the urinary tract at length (16), appears to have recognized the condition involving the urinary bladder only, with reflux into and secondary dilatation of the ureter; he does not specify aganglionic ureter as a definite entity in any of his papers, despite the fact that its occurrence is by now well documented.

A clear discussion of the variable clinical picture appeared in 1948, by Kimbrough *et al.* (15), and of the logical treatment in 1952, by Lewis and Kimbrough (4). The disorder has been substantiated by cineradiography (Edwards, 17) and by surgical observations (Nesbit, 19; Boeminghaus, 10).

PATHOLOGY

The existence of a congenital absence of parasympathetic ganglia in the sigmoid colon with unbalanced sympathetic tone, producing local spasm and proximal dilatation, has been well established. Demonstration of the underlying pathology in the corresponding condition involving the ureters and bladder is much more difficult because of the fact that there normally are very few parasympathetic ganglia in this area (16, 18). Some pathologists (1) feel, however, that the absence or diminution of such ganglia can be objectively determined. It should be noted that where the bladder is primarily involved the disorder has been well substantiated clinically by the relatively accurate methods available for measuring bladder function. Ureteral function is much less easily determined, and the diagnosis must usually be made without benefit of tissue examination.

Boeminghaus (10) describes a thin-walled ureter in obstructive cases seen at surgery, presumably related to decompensation, whereas in achalasia hypertrophy is present. But it is also possible that some cases of advanced megaureter may have had as their original mechanism achalasia followed by decompensation, masking the usual picture of this neurogenic disorder.

Dilatation of the ureter proximal to a site of functional obstruction is well understood by any radiologist who has seen achalasia of the esophagus at fluoroscopy. When we have been accustomed to seeing the ureter on radiographs in instantaneous phases, we cannot fail to be impressed by the activity of ureteral peristalsis as observed fluoroscopically. This method reveals in achalasia a bolus

of urine transported to the distal end of the ureter and abruptly bounced back, while only a small portion passes through into the bladder in a thin stream—the force of peristalsis is not sufficient to overcome the unrelaxing sphincter (17). Only the distal end of the ureter becomes ballooned out, proximal to the spastic terminal segment, although in more severe cases the entire ureter may remain dilated. A possible explanation for the fact that dilatation is greatest in the distal ureter is presented by Williams (7).

CLINICAL PICTURE

Many patients with only slight dilatation of the lower ureters remain asymptomatic and without any abnormal physical or laboratory findings. When abnormal clinical features are present, they are related to the functional obstruction: pain, which is usually vague lower abdominal discomfort rather than renal colic; urine infection; stone formation; and rarely, in severe cases, impairment of renal function. Kimbrough *et al.* (15) point out the interesting variations in the pain pattern, which in 2 of their cases led to appendectomy and in 1 was attributed to a neurosis. All 6 of their patients had albuminuria, and this has been noted by others also, but not explained. Of our 6 patients, 4 had unrelated symptoms, 1 had recurrent abdominal pain, and 1 had chronic pyuria. It is noteworthy that the severity of the pain, when present, is frequently out of proportion to the degree of dilatation of the ureters.

The condition has been reported much more often in men than in women and has been noted least often in children (6, 7, 8). This latter fact does not militate against a congenital origin, but is probably the result of the slow (or absent) progression of the ureteral changes over long periods of time. If the functional obstruction is of high grade, there will be gross ureteral dilatation and renal damage at birth, since the kidneys excrete urine during the fetal stage, and the aganglionic background may be obscured. On the other hand, most cases where the ureter alone is involved present slight to moderate dilatation of its lower portion and a paucity of clinical findings, so that the diagnosis is not made until adulthood, when urographic studies for other reasons are much more common.

ROENTGENOLOGIC PICTURE

The radiologic findings are pathognomonic when ureteral decompensation is not complete. Localized dilatation of only the lower portion of the ureter, particularly with a gradually tapering terminal segment, is produced by no other lesion (see Fig. 1). This has been described as giving the appearance of a snake's head (9). On occasion, the dilated ureter may present a blunt end, with no filling of the narrow segment; this is usually seen in retrograde studies, where the catheter may perhaps increase the spastic contraction. The undilated segment is often more than a centimeter in length and may be well visualized by excretory urography. Demonstration of the lower ureter on the excretory urograms is unusually good, due to the generally unimpaired renal excretion in the presence of a functional obstruction at the terminal end. Characteristically, even when the entire ureter has dilated, the renal pelvis and calyces are not proportionately distended; why this difference in behavior from mechanical obstructions exists has not been explained. An additional typical feature completes the roentgen picture, namely, the absence of elongation and kinking of the ureter despite considerable dilatation.

Fluoroscopy in these cases is almost superfluous but might be of some value when the contracted terminal segment is not demonstrated on films. Active peristalsis should be visible in the dilated ureter, but confirmation of the spastic segment may require use of an image intensifier and is, of course, facilitated by cineroentgenography of the terminal ureter (17). Opaque medium filling the urinary bladder, particularly when the lesion is unilateral so that this occurs early, could obscure the terminal ureter and require use of

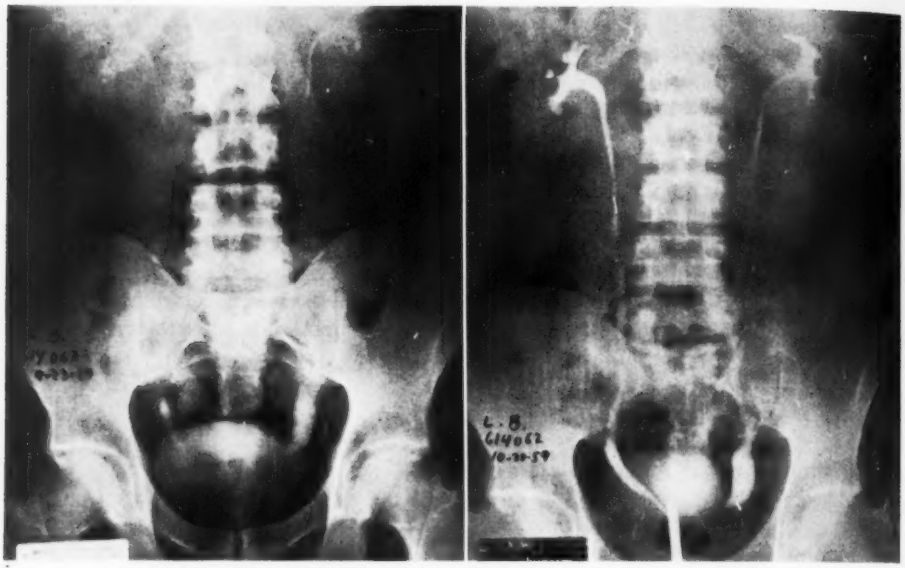

Fig. 1. Case I. Typical features of mild but symptomatic bilateral achalasia, with delayed ureteral emptying on both sides (left, upright view of excretory study) but normal renal architecture (right, retrograde study).

oblique projections or perhaps even of the "squat" position, although we have never had recourse to these views.

It is likely that, in some advanced cases with more than moderate ureteral dilatation, peristalsis might be abolished by the loss of muscle tone in the ureteral wall. However, even in these cases, if there is no neurogenic involvement of the bladder with secondary reflux, the typical tapering of the terminal segment of ureter should be demonstrable.

DIFFERENTIAL DIAGNOSIS

An interesting and important feature distinguishing achalasia from mechanical obstruction lies in the fact that in achalasia, despite considerable dilatation of the ureter, tortuosity and kinking due to elongation are absent. This may be related to enhancement of drainage by the upright position, which probably allows complete ureteral emptying at times throughout the day, whereas in mechanical obstructions the increase in back-pressure by the vertical height of the urine column when the patient is erect is relatively slight in comparison to the elevated pressure already present. A mechanical obstruction must cause rather marked luminal narrowing before any obstructive effect results, in contrast to the varying distensibility of the terminal ureteral segment in achalasia, where the obstruction is functional.

Pyelectasis and caliectasis are not commensurate with the degree of ureteral dilatation in achalasia, again in contrast to mechanical obstructions. In achalasia the dilatation is generally not uniform, being more marked in the lower segment and decreasing, gradually or abruptly, proximally. These differences are not merely qualitative, but are seen to be quite characteristic (15, 19).

The positive findings in many of the specific obstructive lesions are noteworthy, such as the beading of the distal ureter in tuberculous strictures, intraluminal defects due to tumors, stones, or blood clots, extrinsic pressure defects, etc. Signs of obstruction in the bladder suggest reflux as the underlying cause of megaureter.

The other category of causes of megaureter, namely, chronic ureteritis, is probably quite rare. Fluoroscopy would be required to demonstrate the loss of

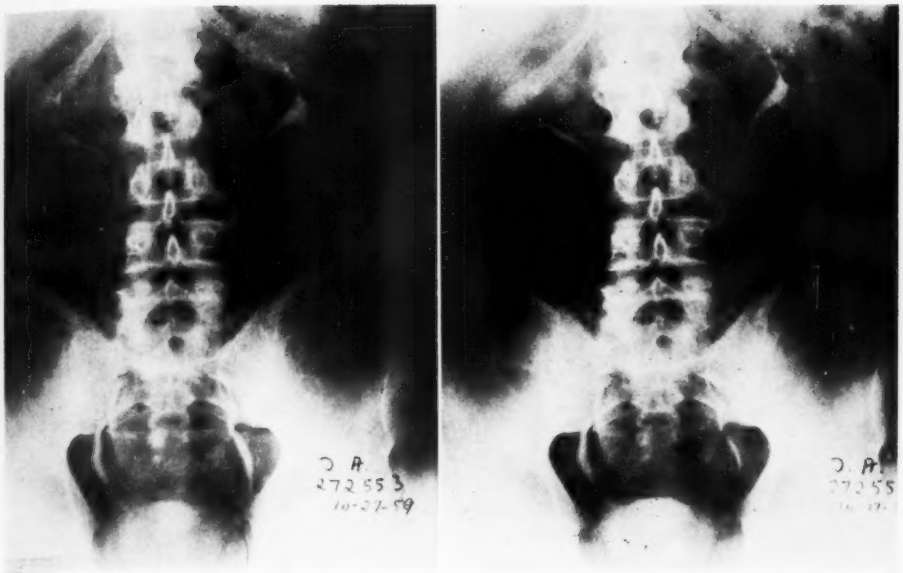

Fig. 2. Case II. Excretory study showing barely perceptible dilatation of pelvic ureters, substantiated by comparison with narrowed terminal segments.

peristaltic activity expected in these cases. Congenital neurogenic atonicity (2) would also be distinguished by dynamic methods.

The diagnosis by the typical radiologic appearance may be substantiated by urologic exclusion of a mechanically obstructing factor. The most important step is calibration of the ureter. In achalasia, a 16F catheter should pass readily through the undilating but not organically narrowed terminal segment, because of the fact that the resistance offered by the ureteral musculature in spasm is in actuality relatively slight. Cystoscopy permits visualization of the ureterovesical orifices, with estimation of their caliber and exclusion of congenital stenosis and Chwalla's membrane. Chromoureteroscopy (20) with a dye such as indigo carmine demonstrates the character of the ureteral jet when renal function is not grossly impaired; this should be of the forceful type seen in the absence of mechanical obstruction.

CASE REPORTS

Case I: A 35-year-old man complained of lower abdominal pain and diarrhea for three days, with dysuria and urinary frequency. A past history of spontaneous passage of a right renal stone or gravel eight years previously could not be objectively confirmed. Urinalysis showed 30 red blood cells and many white cells per high-power field. Diagnosis of cystitis or pyelitis was entertained, and treatment by Gantrisin started.

Ten weeks later the patient was again seen with recurrent dysuria and frequency. He described frequent brief bouts of lower abdominal pain. Urinalysis showed numerous red and white cells. Physical examination was negative. A complete urologic study at this time included a normal cystometrogram. Excretory urography revealed slight dilatation of the distal ends of both ureters, greater on the left, with undilated terminal segments typical of achalasia (Fig. 1). Cineroentgenography with image amplification showed active peristalsis in the dilated ureteral segment but none in the terminal portions of the ureters, which did not distend to a normal caliber. The smoothly tapering configuration of the narrowed segments and the bilateral involvement further excluded the possibility of an old stricture.

Case II: A 56-year-old man presented mild symptoms of prostatism. Physical examination revealed early median bar prostatic enlargement. Excretory urography demonstrated minimal dilatation of the distal segments of both ureters, more noticeable on the right (Fig. 2). The degree of dilatation was so slight that it was identifiable only by comparison with the normal ureters above and with the somewhat long undilated terminal segments, which measured about 3.0 cm. in length. There was no

Fig. 3. Case III. Characteristic sharply localized dilatation with narrowed terminal segment due to persisting spasm, pathognomonic of achalasia. Right ureter normal.

Fig. 4. Case IV. Minimal dilatation of both lower ureters. Delay in filling of bladder by opaque medium in excretory study is a common finding resulting from the functional obstruction present.

elevation of the terminal ureters to suggest that the changes might be secondary to the mild prostatic enlargement. The typical tapering seen in achalasia was clearly visible, and since this was obviously an asymptomatic condition no further studies were attempted.

CASE III: A 55-year-old man was studied because of intermittent pain in the calf muscles while walking. He had no symptoms referable to the urinary tract. Physical examination revealed pulmonary emphysema. Urinalysis was normal. Excretory urography demonstrated moderate, sharply localized dilatation of the pelvic portion of the left ureter, except for the terminal segment, which tapered smoothly to a narrow lumen (Fig. 3). No other abnormal findings were present, and no specific therapy was recommended.

CASE IV: The chief complaint of a 32-year-old man was nocturia for one year. No other present or past symptoms could be elicited, there were no abnormal physical findings, and urinalysis was negative. Excretory urography showed very slight dilatation of the distal ends of both ureters, unequal in degree (Fig. 4). This was felt to be an incidental finding not related to the presenting symptom.

CASE V: A 7-year-old girl was seen with pyuria which did not respond to therapy over a three-month period. Past history included repair of a congenital harelip. At cystoscopy a normal bladder and ureteral orifices were observed, with adequate jets of urine. Excretory urography revealed slight dilatation of the lower half of the right and of nearly all of the left ureter, without tortuosity or kinking. The renal pelves and calyces were not involved (Fig. 5). The possible necessity for specific therapy of the underlying neurogenic disorder would depend upon further clinical observation.

CASE VI: A 59-year-old woman on routine examination was found to have moderate hypertension and urine with a specific gravity fixed near 1.010. Excretory urography revealed excellent excretion and mild achalasia of the left ureter (Fig. 6). Since this was not related to the impaired renal function, no specific therapy was recommended.

TREATMENT

It is most important to note that many cases of achalasia will be found in patients appearing otherwise healthy and that, since this appears to be a non- or slowly progressing disorder, observation at annual intervals may be the best management. In the presence of pain, stone formation, chronic or recurring infection, or renal

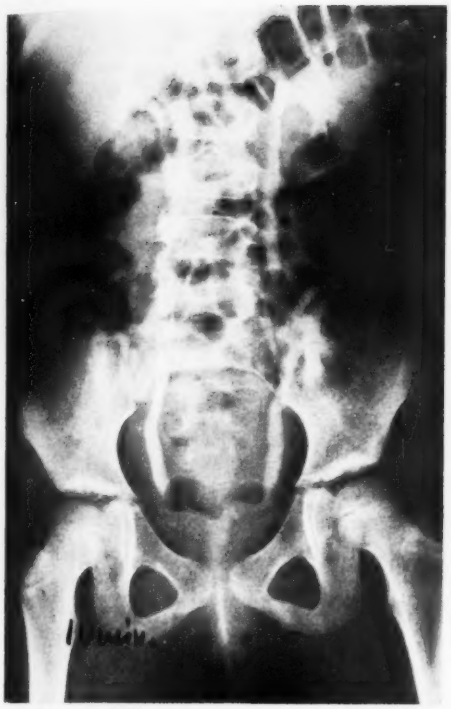

Fig. 5. Case V. Characteristic absence of dilatation of renal pelves and calyces and apparently excellent excretory function despite involvement of most of ureters.

Fig. 6. Case VI. Mild achalasia with no symptoms at age fifty-nine. (Case of Dr. R. Osecheck.)

Fig. 7. Example of more severe lesion (case of Dr. E. L. Lewis) with degree of ureteral dilatation decreasing proximally despite involvement of pelves and renal scarring. Blunt termination of dilated segments frequently seen in retrograde studies, with complete contraction of terminal ureters while catheters are in place.

damage, surgical intervention might be warranted. Resection of the involved terminal segment of ureter is usually feasible because of its short length, but only a few authors (4, 5, 8) have reported favorable results; the difficulty lies in reimplanting the dilated but otherwise normal segment of ureter without the subsequent development of reflux. It must be noted that Swenson (21) contends that resection of the non-dilating ureteral segment is contraindicated because it is here that the few parasympathetic ganglia remaining are located—but he refers to the normal distribution of these nerve cells and may be drawing an unjustified analogy. Some urologists attempt reimplantation of the ureter only into the skin or other drainage site, with notoriously unfavorable results. Nephrectomy would, of course, be curative if only one side were involved sufficiently to produce complications (22).

Replacement of the dilated ureter by a

segment of ileum, described by many (23), has no place in the treatment of true achalasia, where the dilated ureter is functionally relatively normal, and it is to be hoped that these reports are actually dealing with conditions other than aganglionosis. Bladder drainage either directly or by bladder neck resection also has reference to an entirely different syndrome, with involvement of the bladder, whether it be by an obstruction or a neuromuscular disorder.

DISCUSSION

Hereditary occurrence of hydroureter, apparently of the aganglionic type, has been reported (8, 24). This would be expected and it is quite possible that the condition will increase in frequency of occurrence along with other congenital anomalies of the urinary tract as medical investigations and background radiation levels increase.

Radiologists in particular should be well acquainted with the four sites of achalasia now known because this is largely a functional diagnosis which they are in the best position to make. Further order may follow in the chaos represented by the term megaureter. Certainly the advent of image intensifiers could greatly facilitate determination of the etiology of these lesions.

The quite variable symptomatology, when symptoms are present, as noted above, lends merit to the oft neglected urographic examination when biliary and gastrointestinal tract studies fail to elicit the cause of abdominal pain. As a corollary, it must be noted that the intensity of the pain can be considerable even with only a mild and localized ureteral dilatation, evidently being related to the stretching of the wall of the ureter rather than to an obstructive uropathy in the classical sense.

An increased incidence of achalasia with involvement of the bladder has been reported in patients known to have Hirschsprung's disease (21). This is to be expected because of the proximity of the parasympathetic supply to the rectosigmoid and to the urinary tract. Certainly these children deserve to have urographic studies for this reason, and it is likely that among this group cases of isolated achalasia of the ureter without involvement of the bladder will be demonstrated in the future. An association with achalasia of the esophagus is not expected.

When achalasia of the ureter is found in adults, there is usually little if any impairment of renal function in spite of the ominous ureterectasis, and the prognosis remains favorable (19).

SUMMARY

1. Achalasia due to aganglionosis occurs in the colon, esophagus, ureter, and bladder.

2. Achalasia of the ureter is probably much more common than generally suspected. Six new cases are described.

3. The syndrome is frequently asymptomatic in adults, but is nevertheless readily diagnosable by radiologic examination of the urinary tract. When symptoms are present, they are often greater than the demonstrable changes in the ureters would suggest.

4. Recognition of this entity will perhaps permit some disentanglement of the large group of disorders included under the heading megaloureter.

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SUMMARIO IN INTERLINGUA

Achalasia del Ureter

Megaloureter, megaureter congenite, e hydroureter es terminos non-specific applicate a ureteres dilatate de varie etiologias. Inter le conditiones reportate sub iste designationes, un es achalasia causate per aganglionosis, comparabile a achalasia del esophago o del colon. Proque il occurre que le condition es asymptomatic, su recognition es a vices un constatation urographic incidental. Le imagine roentgenographic de un localisate dilatation que es restringite al portion inferior del ureter e sequite de un restriction gradual in le segmento terminal pote esser reguardate como pathognomonic. Quando symptomas occurre, illos es possibilemente foras de proportion con le demonstrabile alterationes.

Le condition es probabilemente de un occurrentia plus commun que lo que es indicate in le litteratura. Illo es incontrate plus frequentemente in masculos que in femininas. Illo es vidite le minus frequentemente in juveniles. Sed isto non argue contra le origine congenite del condition. Le explication es plus tosto probabilissimemente a vider in le lente progresso o le character stationari del alterationes ureteral.

Es reportate sex casos.

Possible Errors in the Arteriographic Diagnosis of Internal Carotid Artery Occlusion[1]

T. H. NEWTON, M.D.,[2] and R. S. C. COUCH, M.D., M.R.C.P., F.F.R.

THE IMPORTANCE of internal carotid artery occlusion is emphasized by the numerous cases recently reported in the literature (4, 6, 8, 11, 16), but, whether partial or complete, it is diagnosed with difficulty, since the clinical picture may resemble such intracranial lesions as cerebral tumour, cerebral haemorrhage, peripheral cerebral artery occlusion, or subdural haematoma. The clinical findings will depend chiefly on the rapidity of the occlusion and on the collateral circulation but may be modified by other factors such as anaemia, hypotension, cardiac failure, or arrhythmias.

Palpation for internal carotid artery pulsation in the neck or pharynx is often misleading. Insufficiency may be suggested by homolateral retinal blanching and syncope on compression of the contralateral side, but the diagnosis must always be presumptive in the absence of carotid arteriography. It is for the radiologist, therefore, to perform the definitive examination, by which the clinical impression is either confirmed or excluded. While previously this condition was of only academic interest, advances in peripheral vascular surgery and in long-term anticoagulant therapy have made accurate radiological evaluation essential.

It is the purpose of this paper to show

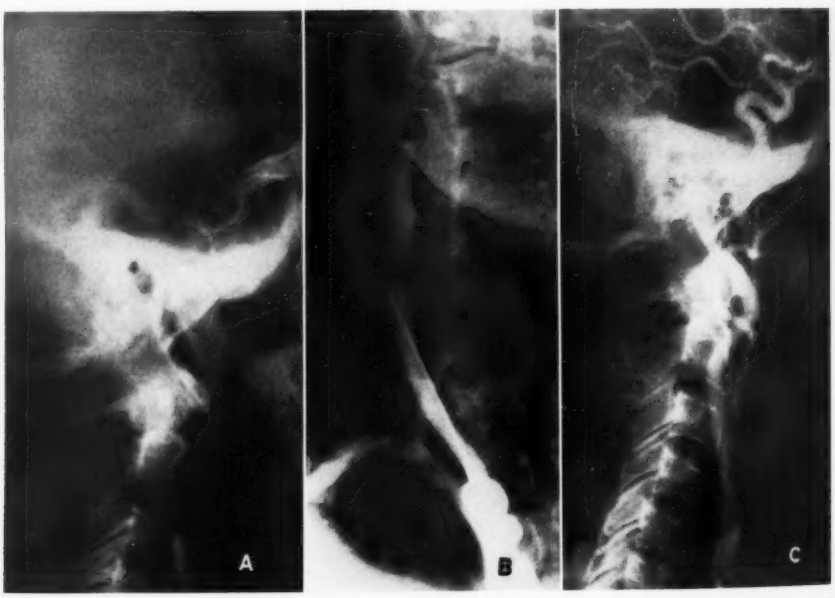

Fig. 1. Case I. A. Contrast medium held up in a subintimal pocket. Very faint filling of internal carotid artery in the neck.
B. Repeat injection showing complete block of both internal and external carotid arteries, with reflux into the subclavian and vertebral arteries.
C. Normal arteriogram obtained five days later. There is no evidence of obstruction.

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that errors in arteriographic technique may result in appearances simulating internal carotid artery occlusion. Few published reports stress the importance of such errors (2, 7, 9). The following cases from the National Hospital for Nervous Diseases, London, illustrate some of the difficulties that may arise.

Fig. 2. Case II. A. Complete obstruction in common carotid artery secondary to partial subintimal injection. Note reflux into vertebral artery.
B. Residual contrast substance in the subintimal pocket at site of injection. Note faint filling of the syphon and middle cerebral artery on this delayed film.

SUBINTIMAL INJECTION

CASE I: I. M., a 60-year-old white woman, was admitted with a history and physical findings suggesting a suprasellar lesion compressing the optic chiasm. A right carotid arteriogram showed only faint filling of the internal carotid artery in the neck, while some of the contrast medium lay subintimally at the site of injection (Fig. 1, A). An anteroposterior film of the neck (Fig. 1, B) during a repeat injection showed complete obstruction of both internal and external carotid arteries, with reflux into the vertebral system. A fine curvilinear negative shadow, representing the stripped intima, was noted just distal to the needle tip. Another examination, five days later, was normal, with no evidence of obstruction (Fig. 1, C).

CASE II: A. M., a 38-year-old white woman with epilepsy of late onset, exhibited features suggesting a focus in the right temporal lobe. Physical examination was negative, apart from possible intellectual deterioration. Electroencephalographic tracings indicated a right temporal abnormality.

A right carotid arteriogram showed complete obstruction to the flow of contrast substance, 1.5 cm. distal to the needle point, with some of the medium lying subintimally at the point of injection (Fig. 2, A) and reflux into the right vertebral and basilar arteries *via* the subclavian artery. A late film in this series revealed retention of the agent in a subintimal pocket. The block was believed not to have been present prior to the examination, but was attributed to faulty puncture, with a partially subintimal injection (Fig. 2, B). Following arteriography, weakness in the left arm and leg developed, with slow recovery. An air encephalogram two weeks later showed no abnormality.

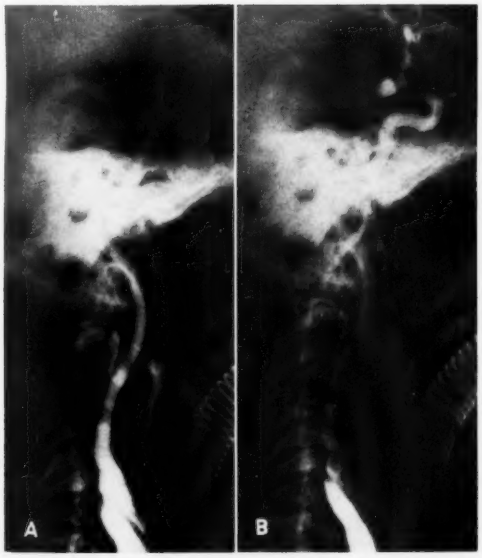

Fig. 3. Case III. A. Negative linear shadow in the common carotid artery, representing the stripped intima. Note slow filling of internal carotid artery.
B. Contrast medium held up in subintimal pocket. Note aneurysm of posterior communicating artery with narrowing of distal syphon, probably representing spasm.

CASE III: S. F., a 58-year-old white man, was admitted a few hours after a subarachnoid haemorrhage. He was drowsy and had marked nuchal rigidity. There was slight right-sided weakness but all reflexes were normal. The blood pressure measured 200/110 mm. Hg. A left carotid arteriogram showed no abnormality.

Ten days later the patient displayed increasing neck stiffness, drowsiness, papilloedema, left central facial weakness, and a left plantar extensor reflex. A right carotid arteriogram (under general anaesthesia) disclosed a large aneurysm arising at the origin of the posterior communicating artery (Fig. 3). Some of the contrast medium injected into the com-

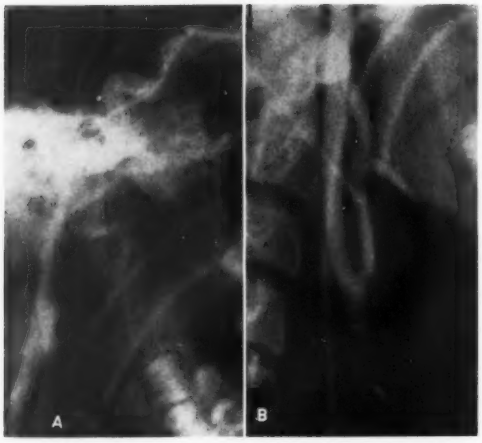

Fig. 4. Case IV. A. Filling of internal carotid artery only as far as syphon (even on delayed films).
B. Subintimal haematoma extending above puncture site.

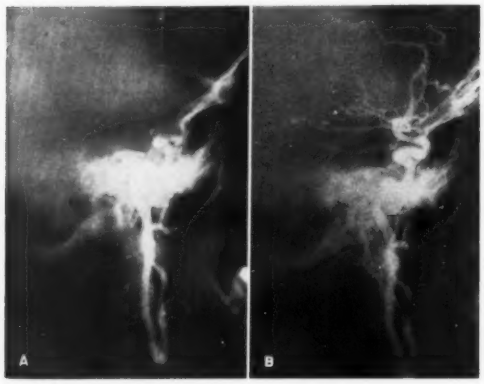

Fig. 5. Case V. A. Small amount of contrast agent lying outside of common carotid artery lumen, associated with localised narrowing of artery. There is no filling of the internal carotid artery beyond the syphon (even on delayed films).
B. Arteriogram showing excellent filling of the internal carotid artery and its branches following repuncture and good injection.

mon carotid artery was shown to be retained in a subintimal pouch, which narrowed the lumen of the artery. Three minutes after injection the patient's blood pressure dropped to 60 mm. systolic and respiration ceased for twenty seconds. The blood pressure returned to normal following intravenous injection of Methedrine, but death occurred twenty-eight hours later.

At postmortem examination both common carotid arteries were found to be normal, and the subintimal dissection demonstrated angiographically on the right side could not be seen. There was an extensive recent haemorrhage from the aneurysm of the posterior communicating artery, which had ruptured. This appeared to be the cause of death.

Comment: Subintimal injection may occur if part of the needle point lies embedded in the vessel wall beneath the intima. The 3 cases described show that such a subintimal injection may closely simulate the picture of internal carotid artery occlusion. This complication can be recognized if serial films of the puncture site show (*a*) retention of the contrast agent in a subintimal pocket or (*b*) a fine negative line within the lumen of the artery, representing the stripped intima. Case III demonstrates the rapidity with which a subintimal dissection may disappear, allowing reconstitution of the normal arterial lumen.

SUBINTIMAL HAEMATOMA

CASE IV. M. C., a 15-year-old white girl, was admitted because of increasingly severe epilepsy. Physical findings were normal, but electroencephalography showed an abnormal focus in the left frontotemporal region.

A left common carotid arteriogram (Fig. 4, A) outlined the internal carotid only as far as the syphon. This appearance was thought to be due to an imperfect puncture, and the artery was repunctured at a higher level. Good visualization of the internal carotid artery and its branches was then obtained and no abnormality was seen. A film of the neck (Fig. 4, B) taken during this second series demonstrated a negative filling defect in the lumen of the common carotid artery distal to the needle point, representing a subintimal haematoma resulting from the first puncture. An air encephalogram four days later was normal.

Comment: A subintimal haematoma can be recognized by a localized negative filling defect in the lumen of the artery. By narrowing the lumen at the point of puncture, the haematoma may impair the blood flow so that contrast medium will not be visualized in the distal portion of the internal carotid artery. The findings simulate a distal internal carotid artery occlusion.

EXTRAVASCULAR INJECTION

CASE V: P. S., a 40-year-old white woman, was admitted with a five-week history of episodes of sudden aphasia and twitching movements of the

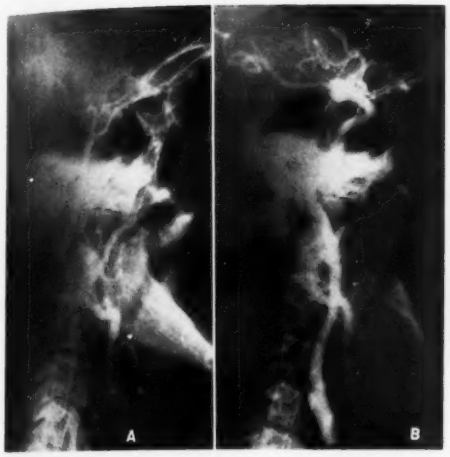

Fig. 6. Case VI. A. No internal carotid artery filling following injection of external carotid near its origin.
B. Good filling of internal and external carotid arteries following common carotid puncture.

right side of the face. Physical examination showed slight central right facial weakness, slight weakness of flexors of the right hip, and a right extensor plantar reflex.

A left carotid arteriographic study was performed. The initial injection (Fig. 5, A) was partially extravascular and no contrast material was seen beyond the syphon. On repuncture, however, there was good filling of the internal carotid artery and its branches (Fig. 5, B). The anterior cerebral artery was displaced to the right and the sylvian vessels were slightly depressed. Encephalography confirmed the presence of a space-occupying lesion in the left frontoparietal region.

Comment: Extravascular injections may cause external compression of the artery, with subsequent impairment of blood flow, mimicking an obstructive process. Local arterial spasm resulting from the presence of extravascular contrast substance may be an additional factor in reducing the speed of blood flow (3).

EXTERNAL CAROTID ARTERY PUNCTURE

CASE VI: W. P., a 66-year-old white man, complained of occasional episodes of paraesthesia of the left forearm for six months, culminating one month before admission in paralysis of the left hand. Physical examination showed weakness and brisk reflexes in the left arm.

A right carotid arteriogram was obtained. The external carotid artery was first punctured, and no

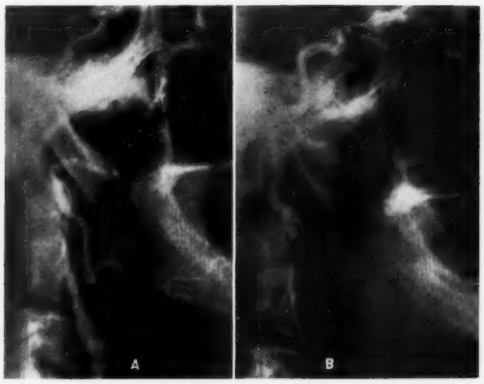

Fig. 7. Case VII. A. Tapering with apparent occlusion of internal carotid artery in the neck.
B. Delayed film showing true site of occlusion in the syphon distal to the origin of the ophthalmic artery.

filling of the internal carotid artery was observed (Fig. 6, A). Good filling was achieved, however, on repuncture of the common carotid artery near its bifurcation (Fig. 6, B). One of the branches of the middle cerebral artery appeared to be occluded.

Comment: Unless the needle point is shown radiographically to lie in the common carotid artery, failure to fill the internal carotid artery may be due to puncture of the external carotid artery (1). This error is particularly likely if the carotid bifurcation is low in the neck.

DISTAL INTERNAL CAROTID ARTERY OCCLUSION

CASE VII: P. C., a previously healthy 60-year-old white man, had experienced progressive weakness and stiffness of the right arm and leg for five months before admission. Physical examination revealed a robust man with spastic weakness. Four days after admission he became aphasic and exhibited a complete right hemiplegia and right facial weakness.

Left carotid arteriography was performed four days after the onset of the hemiplegia. The initial film (Fig. 7, A) showed an apparent occlusion of the internal carotid artery in the neck. On a late film of the same series (Fig. 7, B) the true site of occlusion was found to be just distal to the origin of the ophthalmic artery.

Comment: This case emphasizes the need for delayed films (eight to twelve seconds) to establish the correct site of occlusion. This point was recently stressed by Murphey and Shillito (12).

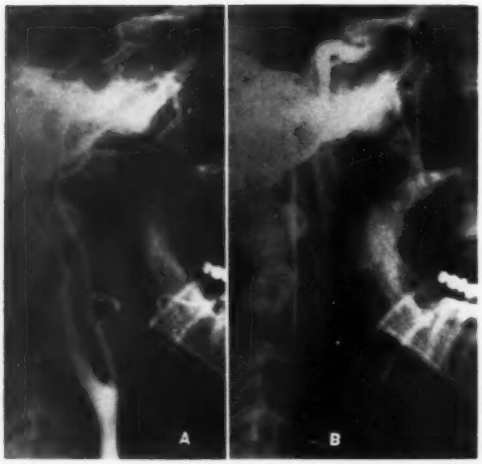

Fig. 8. Case VIII. A and B. Slow filling of internal carotid artery as far as the syphon. Similar findings on other side.

PSEUDO-OCCLUSION ASSOCIATED WITH A SUDDEN INCREASE IN INTRACRANIAL PRESSURE

CASE VIII: R. S., a 28-year-old white man, was admitted, complaining of dysphasia and left temporal headache for three days. There was a past history of slight hypertension and a cardiac murmur. Neurological examination showed mild expressive and receptive dysphasia, a right homonymous hemianopia, and minimal hemiparesis. The cerebrospinal fluid was normal. On the following day physical examination revealed no abnormality. On the third hospital day there was sudden loss of consciousness and spontaneous respiration ceased. Intubation was immediately performed and the patient was placed in a respirator. Lumbar puncture now revealed grossly blood-stained fluid under normal pressure.

Bilateral carotid arteriograms showed slow filling as far as the syphon, with no filling of intracranial vessels even on films taken up to twelve seconds after the injection (Fig. 8). The patient, who was moribund at the time of the examination, died a few hours later.

Postmortem examination revealed a massive intracerebral and intraventricular haemorrhage from a saccular aneurysm of the left middle cerebral artery. The internal carotid arteries were found to be patent. In addition, a coarctation of the aorta of moderate degree was present.

Comment: Filling of the internal carotid artery only as far as the syphon has been described previously in comatose and moribund patients. It appears to be associated with a sudden increase in intracranial pressure (5, 14). This finding is probably due to an alteration in the speed of cerebral blood flow, although the possibility of associated arterial spasm cannot be excluded. The problem is discussed in greater detail by Pribram (13).

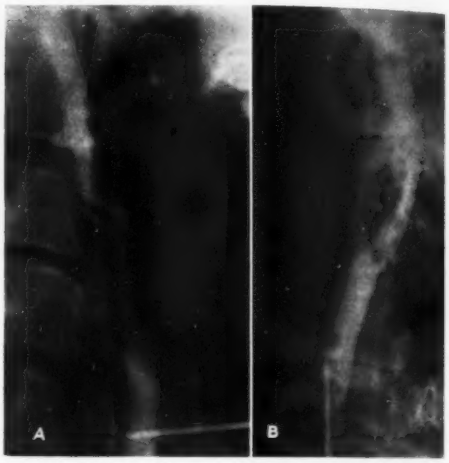

Fig. 9. Case IX. A. Partial occlusion of internal carotid artery at its origin by a calcified atheromatous plaque.
B. Partial occlusion of the internal carotid artery not demonstrated in the anteroposterior projection.

DIFFICULTIES IN THE DEMONSTRATION OF PARTIAL OCCLUSIONS

CASE IX: A. G., a 74-year-old white man, complained of transient episodes of dysphasia and paraesthesias in the right limbs for six months. Physical examination was normal apart from slight arteriosclerotic fundal changes and a blood pressure of 170/100 mm. Hg.

Left carotid arteriography was performed. A lateral film of the neck (Fig. 9, A) showed a calcified atheromatous plaque causing partial obstruction of the internal carotid artery near its origin. This stricture was not visible in the initial anteroposterior view (Fig. 9, B) of the neck because the plaque lay in the posterior wall. In addition, the internal and external carotid arteries overlapped in this projection.

Comment: When clinical findings are suggestive of occlusion of the internal carotid artery, both lateral and anteroposterior and even oblique projections of the carotid bifurcation may be necessary for complete examination of the proximal portion of the artery. This case shows

that an atheromatous plaque cannot be excluded by one projection alone.

DISCUSSION

At the National Hospital for Nervous Diseases (Queen Square, London), carotid arteriography is carried out as described by Lindgren (10). In a proportion of cases the puncture is performed by radiologists who are in training and whose technical experience inevitably varies considerably.

Errors in the interpretation of apparent occlusions of the internal carotid artery are usually the consequence of poor technique, which is often unrecognized. Therefore, when the initial arteriographic appearances suggest occlusion, all possible sources of error must be excluded. In most instances this may be done by visualizing the artery at the puncture site and by obtaining delayed films in the routine series. We feel, moreover, that by observing certain precautions most technical difficulties can be avoided.

Injections made partially into the subintimal tissues cause the greatest number of mistakes in interpretation, particularly if the needle point is not demonstrated radiographically and the presence of this complication is not recognized. Even with needle point partially in the subintimal tissues, we have found that a good pulsatile back-flow of blood may occur.

The possibility of this error may be reduced by observing the return of blood into the plastic tubing after it has been rapidly cleared with saline. When part of the needle point lies in a subintimal position, the initial 1 to 2 c.c. of returning blood will be slightly diluted with saline and appear paler than usual. This can be explained by the formation of a subintimal pocket, in which saline is trapped temporarily; upon release of pressure on the syringe plunger, this saline returns into the tubing mixed with blood. On the other hand, if the needle point is entirely within the lumen of the artery, the initial back-flow will be pure blood unmixed with saline. To appreciate this distinction, the plunger must be loose-fitting (or the syringe detachable from the tubing) in order to allow rapid back-flow once the injection of saline is stopped. If a subintimal injection is suspected, a good flow can often be obtained without repuncturing the artery, by merely adjusting the needle.

The presence of a subintimal injection may be recognized on the radiograph by the fact that contrast substance is retained within the subintimal pocket, or by the presence of a fine negative line representing the loose intima outlined by the medium on either side of it. A subintimal haematoma may similarly reduce the caliber of the lumen of the artery. It can be recognized as a persistent negative shadow on the arteriogram. A partially subintimal injection casts doubt upon a diagnosis of carotid occlusion, and the examination should be repeated by repuncturing the artery at a different level or at a later date.

Sequelae of subintimal injection are usually minimal and transient; the artery may appear normal within twenty-four hours. There have, however, been reports of a subintimal injection acting as a valve-like obstruction and causing complete obliteration of the internal carotid artery, with a fatal outcome (15). The risk of subintimal injection and of initial damage is probably reduced by use of a short-bevelled needle.

The needle point must be shown roentgenographically if technical errors at the site of injection are to be recognized. This is particularly important when a small extraluminal injection narrows the artery sufficiently to reduce the blood flow. The routine lateral series of films often affords the desired information, particularly in patients with average or long necks. With the equipment in current use (Schönander manual cassette changer), however, there is a gap of about 2 cm. between the edge of the cassette holder and the edge of the film and the needle cannot always be visualized on routine

lateral views, particularly if the neck is short. In these cases lateral films of the neck are taken during the injection of 5 c.c. of contrast substance, the film being placed lateral to the shoulder. The lateral projection is preferable, since in it the proximal portions of the internal (posterior) and external (anterior) carotid arteries are usually not superimposed. Both anteroposterior and lateral and possibly even oblique films of the carotid bifurcation may be necessary in some cases to demonstrate the internal carotid artery satisfactorily.

Since the presence of internal carotid artery occlusion may mimic many intracranial disease processes, it is advisable to puncture the common carotid artery as low as possible in all patients. This technique ensures that a partial occlusion of the internal carotid artery near its origin will not be missed, as is likely to occur if that artery itself is punctured. A low puncture also avoids the possibility of an external carotid artery injection. In certain cases selective examinations of the internal or external carotid artery may be performed following the initial examination.

A major difficulty arises when clinical and angiographic findings are suggestive of occlusion of the internal carotid artery, but the injection is not technically perfect. In an attempt to establish criteria for a diagnosis of true occlusion in these cases, two points have been investigated. The first is the presence or absence of spontaneous cross-flow to the suspected side from a contralateral carotid injection. This sign was found to be present in some cases where the carotid arteries were normal and to be absent in 10 out of 23 patients with complete internal carotid artery occlusions on whom bilateral carotid arteriographic studies were performed. Moreover, cross-flow is usually found to occur in acute transient occlusion or compression of the internal carotid artery, as may occur with a poor puncture. The sign is therefore of little diagnostic assistance and examination of the contralateral arterial tree may be dangerous in the presence of carotid artery occlusion (8).

The second point that we have studied is the presence or absence of filling of the distal portion of the syphon *via* the ophthalmic artery. In 100 cases of definite internal carotid artery thrombosis, occlusion proximal to the origin of the ophthalmic artery was demonstrated in 83. In this group we observed collateral circulation filling the distal syphon in 36 patients. The length of the history in these instances tended to be longer than in those not showing collateral circulation. It is therefore suggested that filling of the distal portion of the carotid syphon *via* the ophthalmic artery is unlikely to take place when a temporary occlusion is produced by an imperfect puncture. When filling of the distal portion does occur *via* this route, it probably indicates a true occlusion.

SUMMARY

The possible angiographic errors which may lead to a false diagnosis of internal carotid artery occlusion are discussed. The importance of recognizing and avoiding these pitfalls is stressed.

ACKNOWLEDGMENTS: We are indebted to Dr. J. W. D. Bull and Dr. E. H. Burrows for a critical review of the manuscript. We are grateful, also, to the Medical Committee of the National Hospital for permission to publish the cases.

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SUMMARIO IN INTERLINGUA

Errores Possibile in le Diagnose Arteriographic de Occlusion del Interne Arteria Carotidic

Es discutite le possibile errores angiographic que pote resultar in un false diagnose de occlusion del interne arteria carotidic. Un numero de casos illustrative es presentate.

Le plus gronde numero del errores in le interpretation del radiogrammas es causate per le injection subintimal del substantia de contrasto. Isto pote occurrer si un parte del puncta del agulia veni a jacer in le pariete del vaso infra le tunica intime. Iste complication pote esser recognoscite quando expositiones in serie del sito del punctura monstra un retention del substantia de contrasto in un bursa subintimal o si un negative linea fin es demonstrabile intra le passage del arteria como indication del distachate intima. Le sequellas es usualmente minime e transiente.

Altere fontes de error es hematoma subintimal, le qual pote esser recognoscite per un localisate defecto de replenation in le passage arterial; injection extravascular, le qual pote causar un compression externe del arteria, un restriction del passage, e un simulation de un processo obstructori; punctura del externe arteria carotidic, lo que es un occurrentia particularmente frequente quando le bifurcation carotidic es basse in le collo; occlusion distal del interne arteria carotidic, lo que es demonstrabile a vices solmente in pelliculas tardive; e pseudo-occlusion associate con un subite augmento del pression intracranial.

Occlusion partial es a vices difficile a demonstrar, e—in le presentia de constatationes clinic que suggere occlusion del arteria interne—il es possibile que expositiones lateral, anteroposterior, e a vices oblique deveni necessari pro effectuar un complete examine del arteria proximal.

The Levo-Angiocardiogram in Tetralogy of Fallot: Its Practical Importance[1]

A. CASTELLANOS, M.D., O. GARCIA, M.D., E. GONZALEZ, M.D., R. PEREIRAS, M.D., and H. MERCADO, M.D.[2]

THIS WORK is concerned with the opacification of the left side of the heart by venous angiocardiography in cases of tetralogy of Fallot and with the conditions which affect the degree of this opacification.

Dense opacification of the left side of the heart in the late phase of the angiocardiogram indicates that a considerable quantity of blood has passed through the pulmonary circuit and has arrived in the left atrium and ventricle. It follows, then, that the dextroposition or overriding of the aorta is not marked and that the outflow tract of the right ventricle and the pulmonary vessels are of sufficient size to deliver the blood to the lungs. One reaches the conclusion, therefore, that in most cases of tetralogy of Fallot with dense left-sided opacification of the heart and aorta in the late phase of a venous angiocardiogram there exists a good pulmonary blood flow, but that in those cases which do not show this opacification most of the blood passes into the systemic circulation. There is thus a radiological means of approximately estimating the systemic flow and the pulmonary flow in this anomaly.

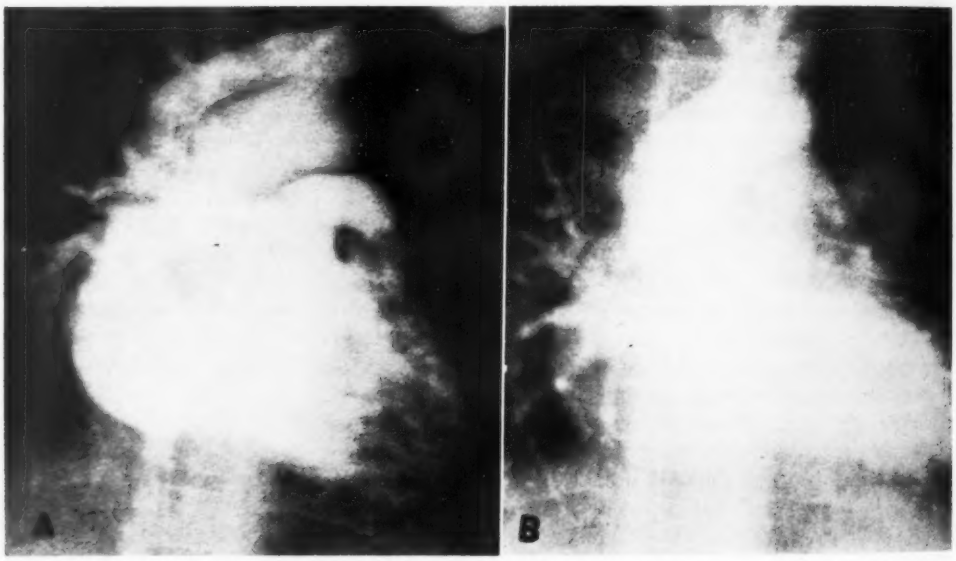

Fig. 1. Angiocardiogram in frontal projection. A. Opacification of the right side of the heart, showing simultaneous filling of the aorta and main pulmonary artery, which is somewhat hypoplastic.
B. Complete opacification of the left side of the heart and the aorta and its branches three and a half seconds later.

MATERIALS AND METHODS

Sixty-six patients with tetralogy of Fallot were studied radiologically and subsequently operated upon by the surgical

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[2] La Paz, Bolivia, Fellow of the A. Castellanos Foundation.

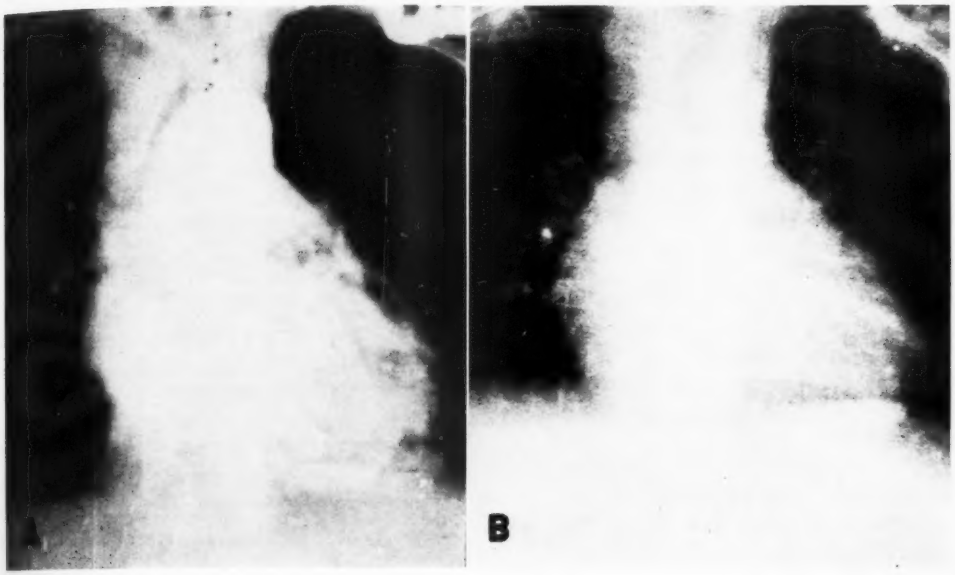

Fig. 2. Venous angiocardiogram. A. Simultaneous filling of the aorta and main pulmonary artery and its branches. There are pulmonary valvular stenosis and poststenotic dilatation of the main pulmonary artery. B. Because of an associated interatrial septal defect (pentalogy), the left ventricle does not become opacified.

TABLE I: LEVO-ANGIOCARDIOGRAMS: DEGREE OF OPACIFICATION IN 66 CASES

	Anteroposterior	Lateral
Faint	6 cases (4.5%)	2 cases (3%)
Moderate	13 cases (19.6%)	1 case (1.5%)
Dense	21 cases (31.8%)	7 cases (10.6%)
No opacification	16 cases (24.2%)	11 cases (16.6%)
Technical failure	7 cases (10.6%)	2 cases (3%)
Angiocardiography not used	3 cases (4.5%)	43 cases (65.1%)

TABLE II: RELATION BETWEEN DIAMETER OF PULMONARY ARTERY AND BRANCHES AND DENSITY OF LATE LEFT VENTRICULAR OPACIFICATION

Caliber of Pulmonary Artery and Branches	Dense Opacification	Moderate Opacification	Faint Opacification	No Opacification	Technical Failure
Normal (10)	8	1	1		
Slight hypoplasia (14)	8	2	1	2	1
Moderate hypoplasia (18)	6	5	1	3	3
Severe hypoplasia (17)			8	9	
Right artery large: left artery normal (2)	2				
Right slightly hypoplastic: left normal (2)				2	

team of the "A. Castellanos Foundation" in the Municipal Children's Hospital (Hospital Municipal de Infancia) in Havana. The operations were performed by Drs. Angel Giral, R. Fojo, and collaborators. The relationship between the diameter of the pulmonary artery and branches and the intensity of opacification of the left side of the heart as observed in the anteroposterior projection is given in Table II.

Of those patients showing radiographic evidence of adequate caliber of the pulmonary vessels, 3 were found to have very slight or no opacification of the left side of the heart and by catheterization were shown to have an interatrial septal defect. One other patient in this group had marked aneurysmal dilatation of the ascending aorta with considerable dextroposition. It is readily understandable that, in the presence of an atrial defect with a left-to-right shunt, much of the opaque material which reaches the left atrium is reshunted

into the right atrium so that opacification of the left ventricle is poor. Comparison of the calculated pulmonary blood flow in the systemic and pulmonary circuits from physiological studies shows no correlation with left ventricular opacification. It is thought that the intensity of the opacification of the left side of the heart is a more reliable criterion.

SUMMARY

1. In 66 cases of tetralogy of Fallot subsequently subjected to surgery, the intravenous angiocardiogram was studied for intensity of late opacification of the left ventricle.

2. The diameter of the right and left pulmonary arteries and of the infundibulum and the pulmonary artery trunk were estimated whenever possible.

3. Late opacification of the left ventricle was found to be dense whenever the diameters of the pulmonary artery and its branches were enlarged, normal, or only slightly reduced, except in the presence of an interatrial septal defect. A single exception to this rule was one case of aneurysmal dilatation of the ascending portion of the aorta.

4. The intensity of the opacification of the left ventricle in the late phases of the angiocardiogram provides a better estimation of pulmonary blood flow than the calculation from the physiological data.

5. The characteristics of the levoangiocardiograms should be carefully determined when studying the tetralogy of Fallot.

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SUMMARIO IN INTERLINGUA

Le Levo-Angiocardiogramma in Tetralogia de Fallot: Su Importantia Practic

In 66 casos de tetralogia de Fallot (subsequentemente presentate al operation), le angiocardiogramma intravenose esseva studiate con respecto al intensitate del opacification tardive del ventriculo sinistre. Le diametro del arterias pulmonar dextere e sinistre e del infundibulo e del trunco del arteria pulmonar esseva estimate in tanto que possibile. Esseva trovate que le opacification tardive del ventriculo sinistre esseva dense quandocunque le diametros del arteria pulmonar e de su brancas esseva allargate, normal, o non plus que levemente reducite, excepte in le presentia de un defecto del septo interatrial. Le sol exception ab iste regula esseva un caso de dilatation aneurysmal del ascendente portion del aorta.

Le intensitate del opacification del ventriculo sinistre durante le phases tardive del angiocardiogramma provide un melior estimation del fluxo de sanguine pulmonar que le calculation super le base del datos physiologic.

Le characteristicas del levo-angiocardiogramma deberea esser determinate cautemente quando un caso de tetralogia de Fallot es studiate.

An Unusual Myelographic Pattern of Arachnoiditis[1]

RICHARD B. MULVEY, M.D.[2]

IN THE USUAL case of arachnoiditis the myelographic findings are well known and have been considered diagnostic. The flow of the contrast medium is impeded by the adhesions which partly obliterate the subarachnoid space. The contrast material takes on a globulated or stringy pattern as it passes between the many adhesions, an appearance which has been likened to that of candle drippings. Once trapped in the subarachnoid space, the droplets of oil may remain unchanged in position for long periods of time.

Similar roentgen signs may be encountered in other conditions. In the case of accidental extradural injection there may also be irregular channeling and separation of the contrast material, with impairment of flow as the medium is trapped in the extradural areolar tissue. Extension along the nerve roots, often well beyond the intervertebral foramina, is the most useful distinguishing feature of extradural extravasation. In subdural injection the flow of the contrast medium may be impeded but the pattern is usually smooth and the circumferential distribution of oil characteristic. Intraspinal vascular malformation may also be difficult to differentiate from arachnoiditis and may even coexist with arachnoidal adhesions if hemorrhage has occurred (1). Generally the defects associated with vascular abnormalities are smooth, sinuous, and more localized than those commonly seen in arachnoiditis. Epidural hemorrhage may also, on occasion, simulate the findings of arachnoiditis quite closely and the two conditions may even be associated.

Occasionally, the obliterative changes of arachnoiditis may produce a sharply localized block to the flow of the contrast medium, usually in the dorsal or cervical region (2). In such cases arachnoiditis, a relatively uncommon cause of complete spinal block, may not be considered in the differential diagnosis (3). This is especially true when the tell-tale myelographic irregularities are absent. In the latter event, the roentgen appearance may be mistaken for that of an extradural tumor. The following case reports illustrate this difficulty in diagnosis and demonstrate a myelographic sign which may prove useful in differentiating this form of arachnoiditis from intraspinal mass lesions.

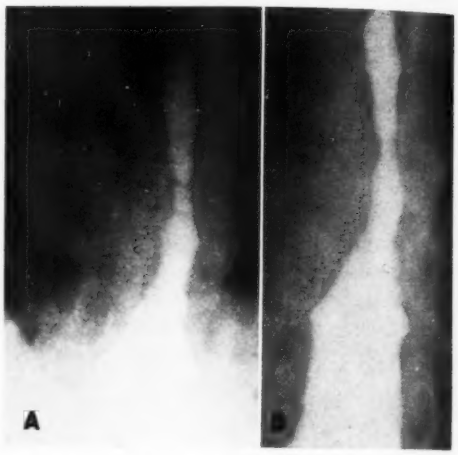

FIG. 1. Case I. A. Complete block of the spinal canal in the dorsal region.
B. Note the midline position of the negative defect of the spinal cord adjacent to the defect.

CASE REPORTS

CASE I: A 60-year-old white female was admitted to Cincinnati General Hospital because of progressive general physical deterioration. She had had syphilis many years earlier, but details of her treatment were not available. She gave a history of lumbar punctures at the time of her antisyphilitic therapy.

Clinically, the neurologic picture was confused by the presence of pernicious anemia and cranial nerve impairment related to vascular disease of the brain. Sensory and vibratory deficits were demonstrated below the level of D 8. On lumbar puncture there

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was evidence of complete block, by the Queckenstedt test, on two occasions. Spinal fluid chemistry, cell counts, and serology were normal.

On myelography a complete block was encountered at the level of D-8. Below this there was no impediment to the flow of the medium and the subarachnoid space was normal. At the site of obstruction there appeared to be a large extradural mass impinging on the spinal canal from the right side (Fig. 1, A). It was noted that the shadow of the cord was not displaced at the level of the block, but the significance of this finding was not appreciated at the time (Fig. 1, B).

At laminectomy, dense fibrous adhesions were found at the level of D-8, with fibrous thickening of the arachnoid, resulting in partial constriction of the cord. There was a complete block to the upward passage of a small catheter at the site of a diaphragm-like adhesion at this level. Lysis of the adhesions was performed but the course was downhill, with death several months later. At autopsy it was found that the obliterative adhesions of the dorsal region had recurred. Histologically, the changes in the arachnoid were considered nonspecific, consisting of fibrous tissue proliferation.

CASE II: A 40-year-old colored male was admitted to Cincinnati General Hospital with multiple gunshot wounds. There was total anesthesia below the level of D-6. Roentgenograms showed that a bullet had lodged in the spinal canal at this level. On laminectomy the missile was found in the extradural space, the dura itself appearing intact. There was no significant hematoma in the area. A nerve root was divided at the intervertebral foramen to facilitate removal of the bullet, and the incision was closed.

Because the signs of cord injury progressed, myelography was performed three weeks after the laminectomy. A sharply defined filling defect was present at the D-7 level. This was thought to represent an extradural hematoma. As in Case I, the bulky mass failed to displace the negative shadow of the cord from the midline (Fig. 2). A second exploration was performed one month after the first procedure. There was no evidence of a mass. The arachnoid was slightly thickened and adherent to the cord in the region of the myelographic defect. The cord and other structures appeared grossly normal. The patient has remained paraplegic from what is believed to be a physiologic transection of the cord.

On later review of the myelograms in these 2 cases it was evident that the extradural "mass" merely represented closure of the subarachnoid space by adhesions. It should have been apparent that the absence of deviation of the spinal cord with such large defects was a straightforward indication that we were not dealing with a mass lesion.

Fig. 2. Case II. Large defect in the area of prior surgery. Note the failure of the apparent mass to displace the spinal cord.

It is felt that the combination of these two myelographic signs—a large defect in the contrast column, even to the point of occlusion of the canal, with absence of cord displacement—may enable one to differentiate localized arachnoiditis from intraspinal tumor.

DISCUSSION

The causes of arachnoiditis are numerous and the inflammatory stimulus may be of almost any type or degree. In a significant number of cases no cause is apparent or even implied, and in others the inflammatory response follows an almost trivial insult to the membranes. There may be as great an individual variation in the tendency to form adhesions in the meninges as there is in the pleural and peritoneal cavities. Pathologically, there is fibrous thickening of the meninges with irregular obliteration of the meningeal spaces by adhesions. Varying degrees of damage to

the underlying cord have been described in association with the adhesive process, even to the point of frank cystic degeneration.

The neurologic consequences of arachnoiditis may be profound. These are usually attributed to interference with the circulation to the cord or to its frank mechanical compression by the dense fibrous adhesions. In many of the reported cases the neurologic findings were mistaken for those of cord tumor. When the myelogram also shows a pattern consistent with this diagnosis, as in one of the present cases and in others recorded in the literature, it is not surprising that the patient may be operated on with a diagnosis of cord tumor.

Davidoff *et al.*, investigating localized arachnoiditis following the removal of cord tumors, found myelographic signs of block resembling recurrent neoplasm in 3 of 5 cases (4). Seaman *et al.* (5) reported 7 cases of block caused by arachnoiditis, 4 of which followed routine spinal anesthesia in normal obstetrical patients. In 4 of these 7 cases, neoplasm was given first consideration both clinically and myelographically. Rosenbaum and his associates described 6 cases of arachnoiditis as a complication of obstetric spinal anesthesia. Five of the 6 showed total block of the spinal canal, closely simulating neoplasm in both their clinical and myelographic aspects (6). In 1 of 4 cases of arachnoiditis occurring as a complication of disk surgery reported by Smolik and Nash, subarachnoid block resembling tumor was demonstrated on myelography (7). In 2 of the 3 cases of arachnoiditis apparently resulting from previous myelography reported by Hurteau *et al.*, the block was similar to that seen with a tumor (8). Epstein (2) also emphasized the clinical and roentgenologic similarity of arachnoiditis to neoplasm in the dorsal and cervical regions. Two of his 23 cases of arachnoiditis involved the dorsal region and both were thought to be tumors prior to operation. Some of these authors expressed the belief that it is impossible in such cases to make a correct preoperative diagnosis; none has mentioned absence of cord displacement as a differential diagnostic sign.

SUMMARY

Arachnoiditis may follow minimal insults to the meninges. While in the cases reported here arachnoiditis was probably not the sole factor responsible for the neurological deficits, adhesions and secondary cord damage have been noted by others to simulate intraspinal tumor clinically. The usual myelographic changes of arachnoiditis may be resembled by other conditions. In some cases, especially in the dorsal region, myelography may show a filling defect with or without a complete block of the canal and suggest the presence of an intraspinal mass. Attention is directed to the absence of spinal cord displacement in such cases in differentiating arachnoiditis from tumor.

ACKNOWLEDGMENT: The author acknowledges with gratitude the patient and helpful assistance of Dr. Benjamin Felson.

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SUMMARIO IN INTERLINGUA

Un Inusual Configuration Myelographic de Arachnoiditis

In le caso usual de arachnoiditis, le constatationes myelographic es ben cognoscite e es generalmente considerate como diagnostic. Ben que le alterationes de arachnoiditis pote esser simulate per altere conditiones, le differentiation es usualmente effectuabile. Tamen, in casos sporadic—specialmente in le region dorsal—le tableau myelographic pote esser un tableau de defecto de replenation, con o sin bloco complete del fluxo del substantia de contrasto, representante un forte suggestion de tumor intraspinal. Duo tal casos es reportate. Un aspecto significative in illos esseva le absentia de displaciamento del medulla spinal al nivello del bloco in le myelogramma. Es proponite que isto es considerate como signo differential in le distinction radiologic inter arachnoiditis e neoplasma intraspinal.

Holoacardius Acephalus

A Case Report[1]

ROBERT L. FRIEDMAN, M.D.[2]

ASIDE FROM A mention by Schinz *et al.* (5), the radiological literature fails to reveal any discussion of holoacardius acephalus, a rare type of fetal monstrosity in which the heart and head are completely absent. This entity can be determined radiographically if the possibility is considered, and it is noteworthy that in the few cases where prenatal roentgen reports are available, a diagnosis of anencephaly was made, as in the case to be presented.

CASE REPORT

B. R., a 28-year-old white female, entered the hospital in labor at term, with ruptured membranes. Her first pregnancy had resulted in a normal male infant 6 lb. 7 oz. in weight after forty weeks gestation, a labor of thirty-six hours, and forceps delivery. A second pregnancy had terminated at six months with normal spontaneous delivery of twins after a labor of seven hours; both infants died within twenty-four hours. The present pregnancy, her third, had progressed normally, with a 19-lb. gain in weight.

On admission to the hospital, all findings were normal except for polyhydramnios of a degree which prevented clinical determination of fetal position and presentation. An abdominal roentgenogram (Fig. 1) revealed a twin pregnancy, with one of the twins appearing normal in the left occiput transverse position, in vertex presentation. The second twin was markedly smaller, in a transverse lie across the upper fundus anteriorly, and no skull could be visualized. The radiographic diagnosis was twin pregnancy, with one normal fetus and one anencephalic monster.

The patient delivered spontaneously after six hours of labor. A normal male infant was delivered first, followed in about ten minutes by the dead monster. A single placenta was delivered by Credé maneuver and revealed a double cord which confirmed the fact of identical asymmetrical twins. It is unfortunate that the blood supply to the umbilical cords was not studied, as this probably holds the clue to the development of the acardiac monster.

The hospital course was normal and the mother was discharged six days after delivery.

Fig. 1. Anteroposterior abdominal roentgenogram revealing twin pregnancy with the normal twin in vertex presentation in left occiput transverse position. The second twin is in a transverse lie in the upper anterior abdomen, and is a holoacardius acephalus. Note relative size of twins.

DISCUSSION

The subject of holoacardius is reviewed in the recent paper of Gillim and Hendricks (1) from the clinical and obstetrical point of view, and the pathology is discussed by Edith Potter (4). The reader is referred to these works for a more complete consideration of the subject.

Prenatal radiographic studies are rare in this fetal abnormality and, when done (Kappelman, 2; Schinz *et al.*, 5), have led to a diagnosis of anencephaly, as in the present instance.

The incidence of holoacardius as calculated by Gillim and Hendricks from the literature is 0.028 per 1,000 births. Anen-

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Fig. 2. Lateral roentgenogram of holoacardius acephalus: prenatal film.

Fig. 3. Photograph of holoacardius acephalus.

cephaly has been estimated by Ru-Kan Lin and Plenk (3) as having a rate of 0.72 per 1,000 births; it is said to be much less frequent in twin pregnancies, but the percentage incidence is not given. Among 315 cases of anencephaly, there were 7 in which one of twins was anencephalic, or 0.016 per 1,000 births. Holoacardius thus occurs almost twice as often per 1,000 births as do anencephalic monsters in twin pregnancies.

Fig. 4. Postnatal film of holoacardius acephalus.

Holoacardius by its very nature must always occur in a twin pregnancy, as the acardiac fetus depends on the functioning heart of the normal twin for its circulation. The abnormal fetus varies from an amorphous mass to a fetus lacking only a well developed head and upper extremities, with all gradations between these extremes. The significant radiographic finding is that the holoacardiac acephalic monster at full term is always much smaller than the normal twin. This can be readily seen on the film of the maternal abdomen which gives a good appreciation of comparative size. In anencephaly, on the other hand, the twins are comparable in size and the fetuses are similar in all respects except for the configuration of the skull. This is well shown in Thompson's (6) report of a case of anencephaly where the normal twin weighed 4 lb. 15 oz. and the anencephalic 3 lb. 10 oz.

It is hoped that the present case report will help to make radiologists more aware of the fetal monstrosity of holoacardius

acephalus and that, as a result, its prenatal radiological differentiation from anencephaly will be more frequent.

SUMMARY

A case of holoacardius acephalus is presented and attention is directed to differentiation from anencephaly.

ACKNOWLEDGMENT: The author wishes to express his gratitude to Dr. Lovell W. Rohr for permission to publish this case report from his obstetrical service.

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SUMMARIO IN INTERLINGUA

Holoacardio Acephale: Reporto de un Caso

Un holoacardio acephale es un feto monstro con un completemente claudite corpore que es disproviste de capite e corde. Le occurrentia de holoacardios es possibile, naturalmente, in nulle excepte pregnantias a geminos, proque le feto acardiac depende pro su circulation del functionante corde del gemino normal. Le significative constatation radiographic es que le monstro holoacardiac acephalic a termino es semper multo plus micre que le gemino normal. In anencephalia, del altere latere, le geminos es comparabile in dimensiones, e le fetos es simile con le exception del configuration del cranio. Es presentate un caso de holoacardio acephale.

Angioma of the Cervical Spinal Cord

Case Report[1]

LEON MORRIS, M.B., F.F.R.

REVIEWING THE literature, Newman (1) stated that 150 cases of spinal cord angioma with full details had been published. The site of involvement was the cervical region in 27 patients, no fewer than 8 of whom were seen because of subarachnoid haemorrhage. Of the total 150 cases mentioned, only 17 presented in this manner. Thus it appears clear that, in contradistinction to spinal cord angiomas at other sites, those in the cervical region are not uncommonly manifested primarily by subarachnoid haemorrhage.

The only mention made by Newman of diagnosis by vertebral arteriography is in connection with the case of Henson and Croft (2), and these authors published no illustrations. Two further examples of cervical-cord angioma diagnosed arteriographically are described by Höök and Lidvall (3). No other case similarly diagnosed could be found in the available literature.

CASE REPORT

A male office worker aged thirty-four was perfectly fit until Oct. 16, 1959, when he experienced sudden pain and stiffness in the back of the neck while watching a play. He felt nauseated and vomited several times. During that evening headache became increasingly severe and there was continuous retching. The patient was admitted to the hospital at 1:30 the following morning, conscious and rational but photophobic. There was marked neck stiffness and Kernig's sign was positive. The pupils were equal and reacted to light and accommodation. The tendon reflexes were exaggerated. The plantar responses were flexor. Lumbar puncture revealed a heavily blood-stained cerebrospinal fluid. The headache continued but the patient remained conscious and alert. On Oct. 27 he was transferred to the Neurosurgical Unit at the Brook Hospital, where he was found to display no abnormal physical signs. Bilateral carotid angiography was performed with negative results. Nine days later severe headache and vomiting recurred and a repeat lumbar puncture again revealed heavily blood-stained fluid. The patient's condition improved and on Nov. 27 a right vertebral angiogram showed an angioma in the spinal canal at the level of the first and second cervical vertebrae (Figs. 1 and 2). Operation was not undertaken. On discharge to the sending hospital three days later, the patient was asymptomatic.

Fig. 1. Lateral vertebral arteriogram: arterial phase. An angiomatous malformation is shown between the laminae of the first and second cervical vertebrae.

DISCUSSION

When a cervical spinal cord angioma presents with spontaneous subarachnoid haemorrhage, it is practically impossible to make a clinical distinction from spontaneous intracranial subarachnoid haemorrhage (2). The presence of bilateral paresis or of girdle pains may be an indication of the spinal situation of the lesion (3), as may also be a bruit over the angioma

[1] From the X-Ray Department, Brook Hospital, London, S.E. 18, England. Accepted for publication in March 1960.

Fig. 2. Film obtained two seconds after that in Fig. 1. The opaque agent has cleared from the vertebral artery. The angioma remains contrast-filled.

Fig. 3. Plain lateral film of upper cervical spine.

(3, 4). In the present case, none of these distinguishing features was present and the diagnosis rested on the angiographic findings.

Often in cases of spontaneous subarachnoid haemorrhage, angiography is confined to bilateral carotid injections and, if these prove negative, no further investigation is undertaken. Nevertheless, if further search is made by vertebral arteriography, even if the vessels of the posterior fossa appear normal, adequate films of the extracranial portion of the vertebral artery may reveal the source of the bleeding. These films can be obtained after direct percutaneous puncture or retrograde subclavian puncture (5), by brachial catheterisation (6), or by retrograde catheterisation of the aortic arch after femoral puncture (7, 3).

It is well recognised that positive intrathecal contrast media are of considerable value in the diagnosis of spinal cord angioma, in which the radiological appearances are almost classical. From the standpoint of spontaneous subarachnoid haemorrhage, the possibility that the source may be discovered in the cervical spinal canal during vertebral arteriography should never be overlooked. In this context, it may also be mentioned that according to Mettler (8) the vertebral artery supplies the spinal cord as far down as the fourth dorsal segment.

SUMMARY

A case of angioma of the upper cervical spinal cord, presenting as a spontaneous subarachnoid haemorrhage and diagnosed angiographically, is described.

The difficulty in clinical diagnosis in these cases is stressed.

The possibility of finding this lesion with vertebral arteriography is emphasised, as is the need for adequate demonstration of the extracranial portion of the vertebral artery in an angiogram which is otherwise negative.

ACKNOWLEDGMENT: I am indebted to Mr. J. R. Gibbs, F.R.C.S., of the Regional Neurosurgical

Unit, Brook Hospital, under whose care this patient was admitted.

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SUMMARIO IN INTERLINGUA

Angioma del Medulla Cervico-Spinal: Reporto de un Caso

Es describite un caso de angioma del medulla supero-cervical que se presentava como spontanee hemorrhagia subarachnoide. Angiographia carotidic bilateral esseva negative, sed un angiogramma dextero-vertebral revelava un angioma in le canal vertebral al nivello del prime e del secunde vertebra cervical.

Es sublineate le valor de arteriographia vertebral e le desiderato de un adequate demonstration del portion extracranial del arteria vertebral in un alteremente negative angiogramma, proque le differentiation clinic inter iste condition e spontanee hemorrhagia subarachnoide intracranial es difficile.

Loculated Pneumomediastinum in the Newborn

A Thymic "Spinnaker Sail" Sign[1]

JOHN E. MOSELEY, M.D.

PNEUMOMEDIASTINUM is not uncommon in the newborn child. It is usually the result of artificial resuscitation or attempts on the part of the infant to overcome tracheobronchial obstruction. In either event it is considered that increased pulmonary intra-alveolar pressure results in the extension of air along the perivascular spaces of the lung into the loose areolar tissue of the mediastinum. Air reaching the mediastinum may rupture the mediastinal pleura, producing a unilateral or bilateral pneumothorax. If mediastinal air tension is sufficiently high and is unobstructed, air may extend into the soft-tissue spaces of the neck or, rarely, into the retroperitoneal space. In some cases, however, the air becomes loculated in the anterior mediastinum, extending to both sides or localizing to one side or the other. In the latter circumstance a lobe of the thymus gland may be displaced laterally, presenting a bizarre appearance in the frontal projection which can lead to some difficulty in interpretation (Fig. 1).

The crescentic configuration of the thymic lobe, in this situation, is similar to that of a wind-blown spinnaker sail. Since the emphysema is limited to the mediastinum, with loculation to one side, there is no paracardiac air shadow on the opposite side and no pneumothorax or cervical emphysema to aid in diagnosis in the frontal projection. A lateral projection of the chest will show air in the anterior mediastinum lifting the thymic lobe off the pericardium and great vessels (Fig. 2). The thymic lobe configuration and the importance of the lateral projection in the diagnosis of loculated pneumomediastinum in the newborn are illustrated by the following case.

Fig. 1. Crescentic sail-like shadow extending out over right lung and representing the displaced right lobe of the thymus.

CASE REPORT

J. A. was born by spontaneous delivery to a 21-year-old Puerto Rican mother after a thirty-seven-week gestation. The labor had lasted fourteen and a half hours and in addition to Demerol and scopolamine the mother had received Nalline one hour prior to delivery. The infant was of full-term size and weighed 3,090 gm. Because of some respiratory difficulty and mild cyanosis shortly after birth, positive-pressure resuscitation and endotracheal aspiration were performed. The response was not satisfactory. Respiratory difficulty and cyanosis continued, and x-ray examination of the chest showed a peculiar crescentic or sail-like density situated in the right upper lung field laterally. This tapered off as it extended downward and medially across the lung (Fig. 1). The appearance was confusing until a lateral projection of the chest was studied and showed air in the anterior mediastinum lifting the thymus off the pericardium and great vessels (Fig. 2). It was then possible to interpret the frontal projection as unilateral loculated pneumomediastinum with displacement of the right lobe of the thymus. The patient was treated conservatively with antibiotics, vapor, and oxygen, and the respiration and color improved gradually over a period of three or four days. An x-ray examination made seven days later showed no evidence of pneumomediastinum on the postero-anterior projection (Fig. 3), but in the

[1] From the Department of Radiology, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in February 1960.

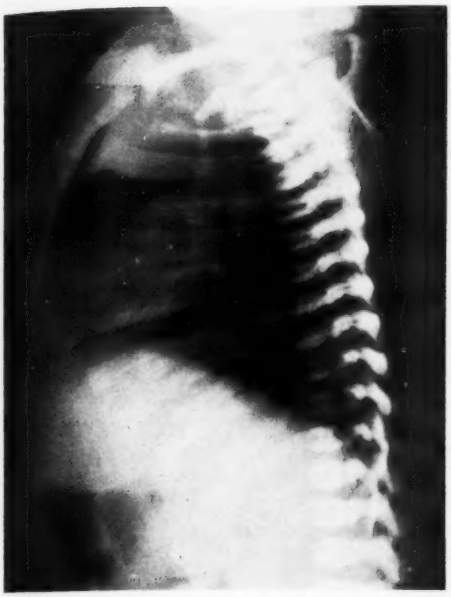

Fig. 2. Lateral projection showing air in the anterior mediastinum, lifting the thymus off the pericardium and great vessels.

lateral projection some air was still apparent in the anterior mediastinum (Fig. 4).

DISCUSSION

In cases of respiratory distress in the newborn it is common practice to examine the chest by means of a single film made in the frontal projection. The shadow cast by a displaced thymic lobe without other supporting evidence of pneumomediastinum is difficult to interpret without a lateral projection if one has had no experience with this unusual finding. The appearance of the chest in Figures 3 and 4 emphasizes the fact that pneumomediastinum may not be detectable in the frontal projection when, at the same time, it is clearly visible in the lateral projection.

The roentgen diagnosis of pneumomediastinum in the newborn infant has been described by Lowman and Culotta (1), Smith and Bowser (2), Keeffe and Jones (3), Caffey (4), and others. Only Caffey, however, has illustrated a thymic lobe displaced far laterally giving the unusual appearance described above. As in the instance reported here, the case shown

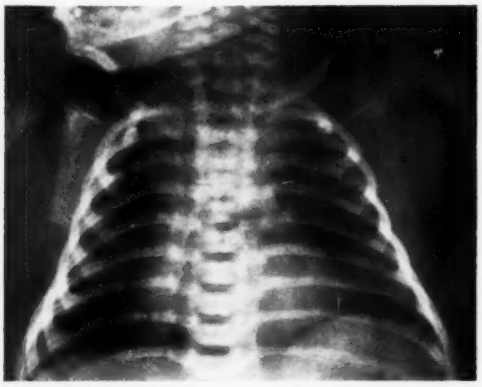

Fig. 3. Frontal projection made seven days later, showing no evidence of pneumomediastinum.

Fig. 4. Lateral projection taken at seven days, showing some residual air in the anterior mediastinum, with slight separation of the thymus from the shadow of the heart and great vessels.

by Caffey was one in which the air was loculated to one side of the anterior segment of the mediastinum.

The experimental work of Macklin (5) has demonstrated that pneumomediastinum may result from overdistention and rupture of pulmonary alveoli, but the physiological anatomy of loculated unilateral anterior pneumomediastinum with

wide displacement of a thymic lobe has not been explained. Nor do we intend to explore the various possibilities in this short report. It is our feeling, however, that the "spinnaker sail" appearance of the displaced thymic lobe in this condition is distinctive and, once seen, makes the diagnosis apparent from the frontal projection alone.

SUMMARY

1. A case of spontaneous loculated pneumomediastinum is reported in which a thymic lobe was displaced far out over the lung, producing a crescentic appearance similar to a wind-blown spinnaker sail.

2. Attention is called to a similar case illustrated by Caffey.

3. It is considered that the appearance of the thymus in this circumstance is bizarre but distinctive and permits a diagnosis of loculated pneumomediastinum from the frontal projection alone.

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SUMMARIO IN INTERLINGUA

Pneumomediastino Loculate del Neonato: Signo de Thymo in Forma de Velo Spinnaker

Es reportate un caso de spontanee pneumomediastino loculate in que un del lobos del thymo esseva displaciate multo super le pulmon, con le resultato de un umbra crescentic suggerente le conformation de un velo spinnaker. Iste umbra inusual esseva situate lateralmente in le campo pulmonar dextero-superior e restringeva se in su extension in basso e centrorse super le pulmon. Le conformation del umbra esseva enigmatic usque un projection lateral del thorace esseva effectuate. Isto demonstrava le presentia de aere in le mediastino anterior, levante le thymo ab le pericardio e le grande vasos.

Es opinate que iste bizarre apparentia del thymo es distinctive e permitte le diagnose de pneumomediastino loculate super le base del projection frontal sol. Un simile caso esseva illustrate per Caffey.

An Extra-Adrenal Pheochromocytoma in a Child[1]

JOHN W. HOPE, M.D.,[2] and RICHARD J. GOLINKO, M.D.[3]

PHEOCHROMOCYTOMAS in the adult are sufficiently common that an individual case report would not be of particular value. In the pediatric age group, however, they are of less frequent occurrence. Indeed, in the 105 years existence of The Children's Hospital of Philadelphia, this is our only example. To publish a case solely because of its rarity is not necessarily a sound justification. This particular pheochromocytoma arose from a site other than the adrenal region, and because of this we feel its teaching value makes it worthy of being reported.

Until relatively recent years, both the neuroblastoma and the pheochromocytoma were thought of as arising only in the suprarenal region. It is true that the majority of neuroblastomas and pheochromocytomas have their origin in the adrenal region, but they may be found anywhere along the sympathetic chain. In the case to be reported the tumor arose at the level of the hilus of the left kidney.

CASE REPORT

A 7 1/2-year-old white boy was admitted to The Children's Hospital of Philadelphia on Dec. 10, 1957, in a semicomatose state. He had been well until about one year prior to admission, when he began to experience transient attacks of frontal headaches and vomiting every three weeks. In the course of time, these became characterized by sweating, clamminess of the skin, and pallor. Between attacks he was asymptomatic. Six months prior to admission, glasses were prescribed because of vague visual disturbances.

At about this same time a gradual onset of polydipsia, polyuria, and personality changes was noted. The patient had always been a cheerful boy, but his family now found him irritable, nervous, and difficult to get along with. Four months before admission he became enuretic, and the attacks increased in frequency, occurring two or three times a week, but always followed by an asymptomatic period.

Three months before admission, while exercising on some climbing bars, the patient suffered his first severe attack. In addition to the symptoms described, there were diffuse abdominal pain, diplopia, ataxia, and disorientation. The attack lasted an hour and terminated abruptly, leaving him free of symptoms. At this time he was referred to a diagnostic clinic where a complete physical examination, including blood pressure determination, was reported as normal. Three weeks later he suffered another severe attack, but again fully recovered.

On Dec. 9, 1957, he experienced his third and most severe attack. This time he did not recover, and remained in a semicomatose condition. On the next day he was admitted to The Children's Hospital of Philadelphia. He was still semicomatose and moderately dehydrated, appearing both acutely and chronically ill. His pulse was 80 and regular, respiration 24 and shallow. He was sent immediately to the X-ray Department for a skull examination, because of the possibility of a brain tumor. The results of this examination were entirely normal, with no evidence of increased intracranial pressure.

On the boy's return to the ward, the physical examination was completed. The blood pressure was found to be 230/150 in the upper extremities and 270/180 in the lower extremities. Other pertinent physical findings were limited to the neurological examination. There was a left seventh and right sixth nerve palsy. The fundi showed bilateral papilledema, narrowing and spasm of the arterioles, and numerous hemorrhages. These findings were interpreted as indicating Grade IV hypertensive retinopathy.

Because of the history and hypertension, a Regitine test was performed. Following the administration of 3 mg. of Regitine intravenously, there was an almost instantaneous fall in blood pressure from the control level of 215/150 to 160/100. Within thirty seconds the blood pressure was 120/65. Shortly afterward the patient had a generalized convulsion lasting two and one-half minutes, from which he recovered spontaneously. The blood pressure gradually returned to the pre-test level.

The result of this test was interpreted as positive for an epinephrine-secreting tumor, either a pheochromocytoma or a functioning neuroblastoma. A

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Fig. 1. Intravenous urogram taken thirty minutes after injection: right posterior-oblique view. The left renal pelvis is not visualized and the filling defect is obvious (arrows).

positive benzodioxane test, and an elevated level of urinary catechol amines of 700 micrograms in a twenty-four-hour collection (normal in children 150–250 micrograms) further confirmed the findings of the Regitine test.

An intravenous urogram was ordered with the hope of localizing the tumor. On the five-minute anteroposterior view following the intravenous injection of 25 ml. of 50 per cent Hypaque, the right kidney appeared normal, but on the left side there was a severe caliectasis of all the calices with no visualization of the renal pelvis. An oblique view at thirty minutes (Fig. 1) showed a greater degree of caliectasis and something appeared to be filling the region of the kidney pelvis, producing pressure on the dilated calices (arrows).

Several hours later a presacral injection of air was carried out on the left side. Most of the contrast medium had been expelled, but a soft-tissue mass filling the region of the hilus of the kidney was seen (Fig. 2). This combined study therefore not only localized the side of the lesion, but actually demonstrated the exact location and size of the tumor.

At surgery (service of Dr. C. Everett Koop) a mass was found in the hilus of the left kidney, bound down to it by a rich vascular supply. In order to minimize manipulation, a nephrectomy was performed with removal of the tumor and kidney together (Fig. 3). Despite this conservative surgical approach, at the time of the ligation of the blood supply to the renal pedicle and tumor, a sharp rise in the blood pressure occurred. This was controlled with 1.5 mg. of phentolamine (Regitine) intravenously. With the removal of the tumor the blood pressure fell immediately to 120/80, where it stabilized for the remainder of the operation.

Pathological examination revealed the tumor to be a benign pheochromocytoma weighing 25 grams. Microscopic study showed typical cords of

Fig. 2. Postero-anterior view of the abdomen following a left-sided presacral air injection. A definite mass is visualized in the hilus of the left kidney (arrows). A little opaque medium is still present in the dilated calices from the previous intravenous urogram.

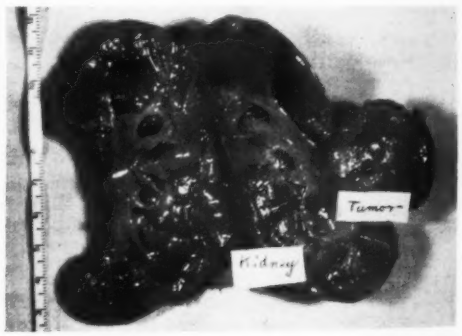

Fig. 3. Gross pathological specimen showing the kidney and tumor on cut section.

polygonal hyperchromatic cells resembling the medullary structure of the adrenal, and having a positive chromaffin reaction. Biochemical assay of the tumor showed that it contained 0.80 mg. of norepinephrine and 0.029 mg. of epinephrine per gram of tumor. The higher level of norepinephrine is the usual finding in pheochromocytomas, and it is this substance which is most responsible for the vasopressor effect of the tumor.

The postoperative course was uncomplicated, with

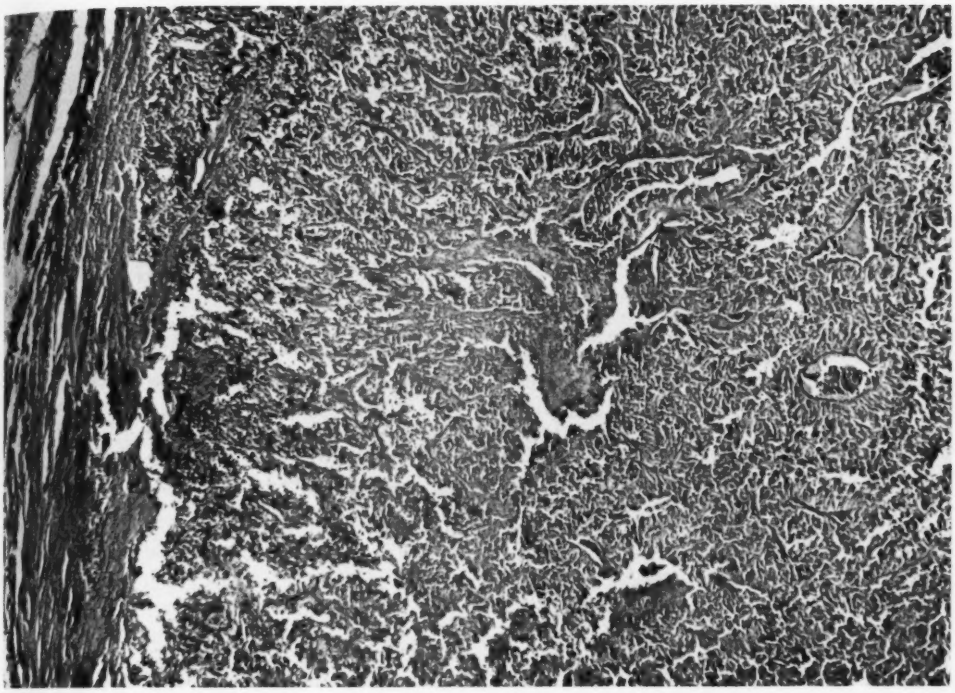

Fig. 4. Microscopic section of the tumor showing a dense fibrotic connective-tissue capsule and typical cords of large polygonal hyperchromatic cells that appear to resemble the medullary structure of the adrenal.

the blood pressure remaining stable at 120/80. There was gradual resolution of the neurological signs and retinopathy, and the boy was discharged on the thirtieth day of hospitalization. He has been followed for two years in the Out-Patient Department; his blood pressure has remained normal and there has been no evidence of residual neurological dysfunction up to the time of this report.

DISCUSSION

The pheochromocytoma or chromaffinoma arises from adult chromophil cells which secrete both epinephrine and norepinephrine. Aggregates of these cells normally form nests of chromaffin tissue not only in the adrenal medulla, but in all the sympathetic ganglia and the carotid body. Because of this, a pheochromocytoma may arise anywhere along the sympathetic chain. Of 34 reported pheochromocytomas in children less than fourteen years of age, 7 have been extra-adrenal (1). Of these 7 cases, one proved to be in the hilus of the right kidney (2), and one medial to the lower pole of the left kidney (3). The present case, therefore, is not the first to be described at this site.

SUMMARY

A case of a pheochromocytoma in a seven-and-one-half-year-old boy, arising in the hilus of the left kidney, is reported.

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(*Pro le summario in interlingua, vider le pagina sequente*)

SUMMARIO IN INTERLINGUA

Un Pheochromocytoma Extra-Adrenal in un Patiente Pediatric

Es presentate un caso de pheochromocytoma in un puero de septe annos e medie de etate, a base in le hilo sinistro-renal.

Pheochromocytomas o chromaffinomas es originari de adulte cellulas chromophile que secerne tanto epinephrina como etiam norepinephrina. Aggregatos de iste cellulas forma normalmente nidos de tissu chromaffin non solmente in le medulla adrenal sed etiam in omne le gangliones sympathic e in le corpore carotidic. Per consequente il es possibile que un pheochromocytoma se forma in non importa qual sito al longo del catena sympathic. Inter 34 reportate casos de pheochromocytoma in juveniles de minus que 14 annos de etate, 7 esseva extra-adrenal. Inter iste 7, un se provava situate in le hilo del ren dextere e un altere in sito medial con respecto al polo inferior del ren sinistre. Le hic reportate caso, per consequente, non es le prime describite pro iste location.

SUMMARIO IN INTERLINGUA

Pseudotumor Hemophilic del Ilium

(*Pagina 795*)

Un inusual manifestation roentgenographic de hemophilia es discutite brevemente e illustrate per le reporto de un caso del si-appellate "pseudotumor" occurrente in le ilium.

Le diagnose de tumor a cellulas gigante es usualmente basate super le apparentia roentgenographic sol, sed le cognoscentia del tableau clinic es de grande adjuta in establir le diagnose. Viste que biopsias es contraindicate a causa del tendentia hemorrhagic, le mesuras therapeutic debe esser influentiate per le opinion del radiologo.

Le alterationes pathologic incontrate in iste casos suggere que le apparentia radiographic es le effecto de multiple hemorrhagias intra-os-see que destrue e expande le osso le qual essaya a effectuar un reparo per fibrosis e trabeculation.

Hemophilic Pseudotumor of the Ilium[1]

ENRIQUE SCHWARZ, M.D.[2]

THE CHANGES occurring in the skeletal system in patients with hemophilia have been thoroughly described and are well known to the radiologist (1, 7). An uncommon radiographic manifestation is the so-called hemophilic "pseudotumor" of bone, which may occur in the extremities or the pelvis, mimicking the radiographic features of bone neoplasms (2, 4, 6, 11).

Several reports of pseudotumors of the iliac bone have appeared recently (3, 6, 10), following the original case of Forfota, quoted by Petersen (9). An additional example is reported here, substantiated by autopsy findings.

CASE HISTORY

A 25-year-old-man, with a twelve-year history of hemophilia, had experienced frequent hemorrhages into the tissues and serous cavities. Four years before admission a large hematoma had developed in the right lumbar area. This eventually broke through the skin and later became infected.

In spite of intensive radiation therapy, the patient died three months after admission. At autopsy, a large necrotic area was found in the right lumbosacral region, leading into a large cavity, bounded anteriorly by peritoneum and extending from the right kidney down to the mid-thigh region. The iliac bone showed a large defect bounded by soft necrotic bone reflecting the roentgen changes.

COMMENT

In rare instances hemophilia can produce osseous changes elsewhere than in the joints, which cannot be differentiated from those occurring in bone tumors. Biopsy is contraindicated in such cases because of the obvious danger of intractable bleeding; therefore, the treatment to be followed will be greatly influenced by the opinion of the radiologist.

Fig. 1. Roentgenogram of the pelvis showing a large, irregular area of bone destruction at the right ilium, limited by well defined margins and associated with a large soft-tissue mass. A fracture through the cortex is noted at the level of the crest (arrow).

Fig. 2. Oblique view of the osteolytic lesion of the squama of the right ilium demonstrating a discrete trabecular pattern. A diagnosis of giant-cell tumor was entertained and the patient was given radiation therapy with no response.

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Hemorrhages occurring in or about the structures surrounding the ilium may produce osteolytic changes which appear on the roentgenogram as irregular, cyst-like, trabeculated areas with sharp, "soap-bubble" margins. Fractures through the cortical bone may occur. These findings resemble those of a giant-cell tumor of bone, the diagnosis usually entertained.

Similar radiographic features can be found when the iliac bone is affected by sarcoma, chondroma, myeloma, cyst, and metastatic neoplasm. A case of tuberculosis of the ilium was reported by Perazzini (8) with identical roentgen manifestations, and Hood and co-workers found this picture in a patient with echinococcus cyst of the ilium (5).

These hemophilic pseudotumors afford a prime example of the major role which may be played by the clinical picture in establishing a diagnosis. A painless mass is first noted by the patient, who may report the occurrence of repeated hemorrhages with localized hematomas. The bleeding time is usually prolonged or there may be a well documented history of hemophilia. Typical roentgen changes may be found in the peripheral joints, but the presence of two or more osseous pseudotumors occurring in the same patient has not been reported.

The pathological changes found in these cases suggest that the radiographic appearance is due to multiple intraosseous hemorrhages destroying and expanding the bone, which shows attempts at repair, with fibrosis and trabeculation. Degeneration, subsequent hemorrhages, and secondary infection occurring in a devitalized area complicate the picture.

SUMMARY

An unusual radiographic manifestation of hemophilia is briefly discussed and illustrated by a case report of so-called "pseudotumor" occurring in the ilium. A diagnosis of giant-cell tumor is usually suggested by the roentgen appearance alone. Since biopsy is contraindicated because of the bleeding tendency, therapeutic measures are largely dependent upon radiographic interpretation. The occurrence of this unusual manifestation of hemophilia should be well known to the radiologist.

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(Pro le summario in interlingua, vider le pagina 794)

Uranium X-Ray Grids[2]

MICHEL TER-POGOSSIAN, Ph.D., and SVEN LEDIN, Ph.D.

THE X-RAY GRID is a device used in diagnostic roentgenology with the purpose of preventing radiation scattered by the object examined from reaching the detector used in the examination. Most grids conventionally constructed are composed of a number of lead strips, approximately 0.002 inch thick, separated by material relatively transparent to x-rays. The grid is characterized by the number of lines per unit length and by its "ratio," *i.e.*, the ratio of distance between two adjacent lead strips to their height.

The purpose of this paper is to study the advantages which can be gained by replacing lead in otherwise conventional x-ray grids with uranium and to report on the practical improvement thus achieved.

If one considers the most desirable requirements for a grid constructed according to conventional design, one reaches the conclusion that ideally the x-ray-opaque strips should be infinitely thin. On the other hand, they must absorb a large fraction of the scattered radiation. The combination of these two conflicting requirements calls for the use of a material with the highest possible linear x-ray absorption coefficient for the scattered radiation present. Most conventional grids are constructed with lead strips. X-ray absorption, in the energy range under consideration, takes place in elements of high atomic number, mostly by photoelectric effect. It appears, therefore, that considerable gain in x-ray absorption might be expected if lead were replaced by an element of higher atomic number. An examination of the periodic table of elements indicates that uranium should serve this purpose admirably. It has one of the highest densities and the highest atomic number among naturally occurring elements. Its radioactivity is insufficient to be a troublesome factor for the contemplated purpose. Chemically, uranium is relatively inert. Physically, it is harder than lead. Thanks to its importance in reactor technology, its metallurgy is well known, and thin uranium foil is available.

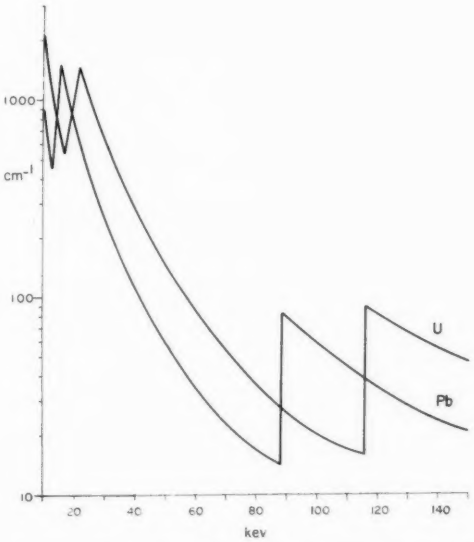

Fig. 1. Linear x-ray absorption coefficients of lead and uranium. (From the calculations by Charlotte M. Davisson, "Beta and Gamma Ray Spectroscopy," edited by Kai Siegbahn. New York, Interscience Publishers, Inc., 1955.)

Figure 1 is a plot of the linear x-ray absorption coefficients of lead and uranium for radiation energies from 10 to 150 kev. The curves were drawn on the basis of the figures calculated by Charlotte M. Davisson and published in *Beta and Gamma Ray Spectroscopy*, edited by Kai Siegbahn. These curves exhibit the "K" and "L" peaks characteristic of photoelectric absorption. Between 22 and 88 kev, uranium absorbs more than twice as much radiation as an equal thickness of lead. This energy

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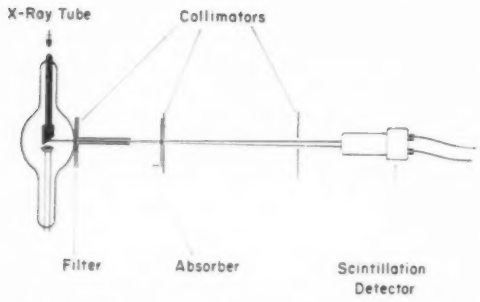

Fig. 2. Experimental apparatus used in the determination of "narrow beam" x-ray absorption coefficients of lead and uranium.

to 200-kev peak range. In the latter case, only a small fraction of scattered photons will have energies in this narrow range.

The above considerations are based on x-ray absorption coefficients versus discrete x-ray energies. In diagnostic roentgenology, the radiation used is never monochromatic, nor is the scattered radiation. The theoretical considerations must therefore be supplemented with experimental measurements. The experimental procedure used for these studies consisted in measuring the absorption of x-rays of

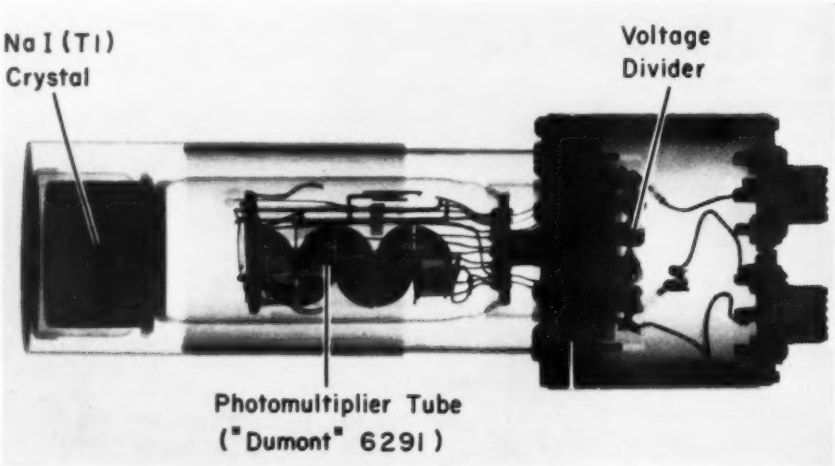

Fig. 3. Roentgenogram of the scintillation counter head used in the apparatus shown in Fig. 2.

range comprises the majority of scattered radiation energies encountered in conventional roentgenologic technics. On the other hand, between approximately 14 and 20 kev and between 88 and 116 kev, lead, per unit thickness, is a better x-ray absorber than uranium. This is due to the presence in these energy ranges of the lead "L" and "K" absorption peaks. Radiation scattered in the 14 to 20 kev range is not particularly troublesome: it is usually scattered at large angles and is easily absorbed by even the most inefficient grid or filter. Photons scattered with energies between 88 and 116 kev are seldom encountered in conventional roentgenology because they result only from small-angle scattering of x-rays generated with energies in the 100-

various energies in lead and in uranium.

The apparatus is shown in Figure 2. It consists in a source of x-rays, a series of collimators, and a scintillation radiation detector. The absorbers used were "lead" foil (composition 99 per cent Pb, 1 per cent Sn) and uranium foil.

Two x-ray generating units were employed in the experiments: (1) A rotating anode x-ray tube connected to a conventional half-wave rectified circuit was used in the energy range between 27.5 and 115 kev. (2) A 220-kev Villard circuit therapeutic x-ray unit was used in the 120- to 200-kev energy range.

The distance between the source of x-rays and the detector was about 1 meter. The diameter of the beam at the detector

	Peak Energy	Added Filtration	Half value Layer	Effective Energy	1/10th value layer for Pb	1/10th value layer for U	Ratio 1/10th V.L. Pb / 1/10th V.L.U
	kev	cm.	cm.	kev	cm.	cm,	
1.	27.5	0	0.1 Al	22	0.004	0.0016	2.5
2.	60	0.32 Al	0.425 Al	35	0.019	0.0075	2.53
3.	80	0.32 Al	0.65 Al	48	0.032	0.013	2.45
4.	115	0.32 Al	0.9 Al	60	0.044	0.025	1.76
5.	140	0.3 Al	0.075 Cu	74	0.051	0.033	1.54
6.	200	0.3 Al	0.1 Cu	81	0.064	0.038	1.69
7.	120	0.3 Cu +0.1 Al	0.15 Cu	100	0.055	0.053	1.04
8.	200	0.3 Cu +0.1 Al	0.25 Cu	130	0.102	0.058	1.76

Table I.

was from 0.5 to 1.0 cm. A large-diameter beam was used for low-energy measurements because of the low intensity of the x-radiation generated. The absorbers were placed at approximately 50 cm. from the detector, the absorption measurements being thus of "narrow beam" geometry. The radiation detector was a scintillation counter connected to a direct current, vacuum tube microammeter. The head of the scintillation counter is shown in Figure 3. The crystal is a thallium-activated sodium iodide cylinder, 1 inch thick and 2 inches in diameter. The tube is a "Dumont" 6291 photomultiplier, connected in such fashion that the current flowing through it is recorded by the microammeter. The current measured was proportional to the energy dissipated in the crystal by the x-ray beam. The thickness of the crystal was sufficient to absorb most photons used in this investigation.

The results of the measurements performed are shown in Figure 4, where they are plotted as percentage of radiation transmitted *versus* absorber thickness. Curves were obtained for x-radiation energies ranging from 22 kev to 130 kev *effective energy*. The effective energies were determined by measuring the half-value layers

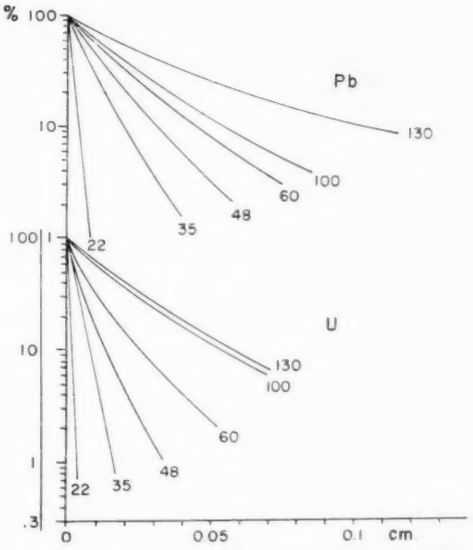

Fig. 4. "Narrow beam" absorption of x-rays in lead and uranium. The numbers under the curves refer to *effective x-ray energies* in kilo electron-volts.

of the radiation in aluminum and copper. The results of these measurements are summarized in Table I.

No attempt was made to determine the absorption coefficients of lead and uranium for the radiations studied, because of the variation of these coefficients demon-

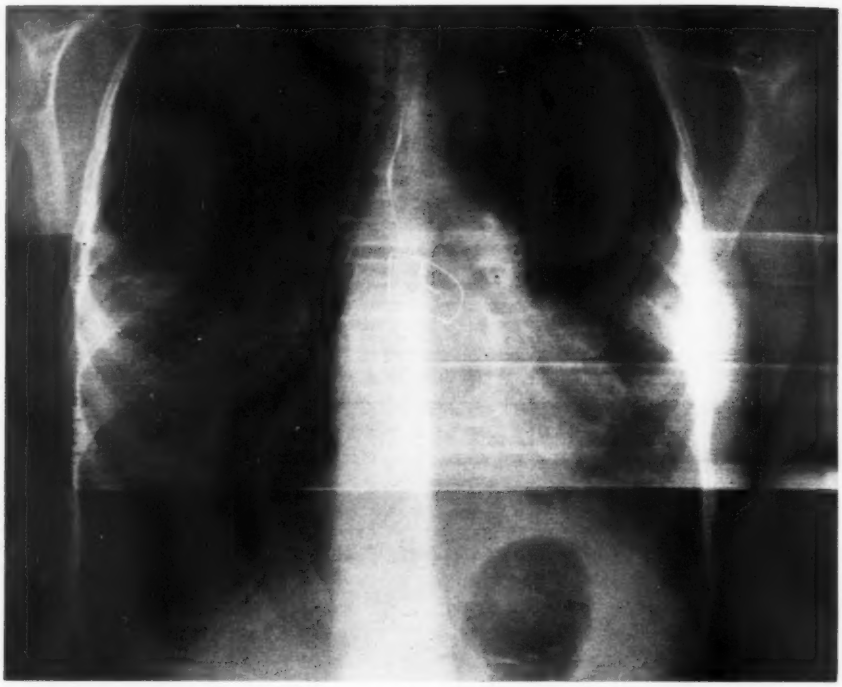

Fig. 5. Roentgenogram of the chest of a 13-year old girl showing the relative "clean-up" of lead and uranium grids. The grid used was obtained by replacing the central portion of a conventional lead grid with a uranium grid of similar ratio and strip thickness.

strated by the curvature of the semilogarithmic plots of the absorption curves. It was felt, however, that a comparison of the tenth-value layers for the two metals studied would be of practical value. The tenth-value layers which were calculated on the basis of the curves in Figure 4 are shown in the last column of Table I. The ratio of the tenth-value layers passes through a minimum for radiation with an effective energy of 100 kev, which is in the range between the "K" absorption peaks of lead and uranium. It should be noted that particular efforts were made to demonstrate the relative drop of the absorption coefficient of uranium with respect to that of lead, in this energy range. This effect was achieved by narrowing the x-ray spectrum generated with a peak energy of 120 kev by means of a particularly heavy filter (3 mm. Cu + 1 mm. Al). Radiation with such a narrow spectral distribution is seldom encountered in diagnostic roentgenology, and it is legitimate to state that in the x-ray energy range between 30 and 200 kev peak, uranium is a better grid material than lead.

The following conclusions can be drawn from the figures shown in Table I: (1) In the "conventional" diagnostic x-ray energy range, *i.e.*, radiation generated up to 100 kev and filtered with 3 mm. of aluminum, uranium x-ray grids can be used with plates 2.5 times thinner than conventional lead plates. (2) Between 100 and 200 kev peak, uranium plates can be approximately 1.6 times thinner than lead plates. In the latter case, the "clean-up" effect achieved with uranium grids should be superior to that obtained with lead because of the greater differential in absorption between the two metals for lower energy wide-angle or multiple scattered radiation.

The superiority of uranium over lead,

as grid material, can be exploited in two ways: (1) uranium grids can be constructed with specifications identical to those for conventional lead grids. The "clean-up" effect thus achieved with uranium grids will be superior to that obtained conventionally. Figure 5 shows a roentgenogram obtained with the use of two strips of lead grid with a uranium grid interposed. The grid ratio and the thickness of the grids are identical for lead and uranium. It is quite apparent that the uranium grid provides better "clean-up." (2) Uranium grids can be constructed with grid lines thinner than lead grid lines. This approach would result in grids absorbing less primary radiation and exhibiting less objectionable grid lines.

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SUMMARIO IN INTERLINGUA

Grillias de Radios X Construite in Uranium

Le grillia de radios X es conventionalmente construite ex strias de plumbo. Esseva ponite le question si non un ganio considerabile in le absorption de radios X resultarea del reimplaciamento del plumbo per un elemento con un plus alte numero atomic. Pro iste objectivo uranium esseva seligite. Se monstrava que in le region de energia del radiographia diagnostic conventional—i.e. con radiation generate usque a 100 kev e filtrate con 3,0 mm de aluminium—grillias de uranium pote esser usate con placas 2,5 vices plus tenue que le placas de plumbo conventional. Inter 100 e 200 kev maximal, placas de uranium pote esser approximativemente 1,6 vices plus tenue que placas de plumbo.

Le superioritate de uranium in comparation con plumbo como material de grillia pote esser exploitate in duo maneras. (1) Grillias de uranium pote esser construite secundo specificationes identic con illos pro grillias conventional de plumbo. In iste caso le effecto "nitidante" que resulta del grillias de uranium va esser superior. (2) Grillias de uranium pote esser construite con lineas plus tenue que in le caso de plumbo. Iste procedimento resultarea in grillias que absorbe minus radiation primari e exhibi minus objectionabile lineas de grillia.

A Field-Shaping Device for Use in Short Wave Length Radiation Therapy[1]

S. GORDON CASTIGLIANO, M.D.,[2] and C. JULES ROMINGER, M.D.[3]

IT IS THE purpose of this paper to describe a device, designed by one of the authors (S. G. C.) by which small-portal radiation therapy of the type currently delivered with orthovoltage equipment to irregularly shaped portals (1) may be carried out with either supervoltage x-ray or cobalt-60 apparatus. This device has been in continuous use for the last eight years and has proved to be quite satisfactory.

Because of the increased tolerance of the skin at the higher voltages, the use of relatively small, well defined, shaped portals has not been as strongly emphasized with this type of therapy as with the use of orthovoltage equipment. Until very recently, there has been no attempt to use any type of asymmetrically shaped portal for irradiation of short wave length. The more recent models of the Van de Graaff 2,000,000-volt generator are equipped with optional beam-shaping accessories but these are intended for use with relatively large-field therapy. The "Theratron F" cobalt teletherapy unit of the Commercial Products Division of Atomic Energy of Canada, Limited, has been released with a satellite diaphragm fixed to the machine rather than the treatment couch. The advantages attending a simple yet effective means of controlling and shaping the irradiated volume should be immediately clear to all who are interested in short wave length therapy.

Small-portal shaped-beam therapy has been most useful in our hands for malignant disease in and about the head and neck (Fig. 1) and for breast cancer (Fig. 2). It has been our practice for many years to employ such fields in treating neoplasms of the oral cavity, accessory nasal sinuses, pharynx, and neck, and their attendant metastases, by both orthovoltage and supervoltage radiation (1, 2). As is well known, it is possible to deliver much larger doses of radiation with a greater degree of safety through small portals, with shielding of vital structures than when large fields are used.

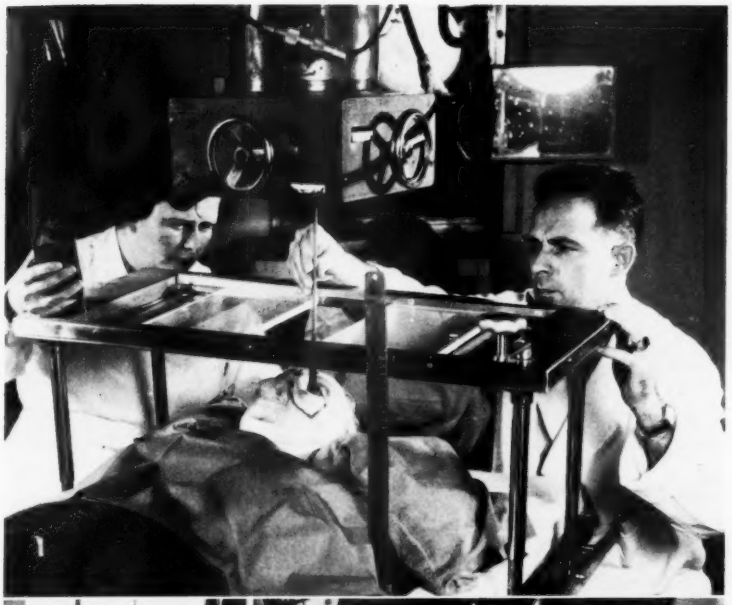
It is imperative that certain structures, such as the cervical spinal cord, the brain, and the orbital contents, be protected from irradiation, if not involved by tumor. For example, in treating a cancer of the maxillary antrum in which the orbit is not involved, we have for some years made use of shaped antro-ethmoid portals, using supervoltage irradiation prior to radical resection (3). Portal films made with the device described here have shown a well defined beam conforming to the outline of the desired portal with a very small penumbra, and the orbital structures are adequately protected (Fig. 3). The adequacy of this protection is borne out by the fact that patients have normal eyes many years following treatment delivered in this manner.

The device which we use for detailed shaping of a short wave length radiation beam consists of a platform with a Lucite surface. It is maneuverable in both the vertical plane, on adjustable legs, and in the horizontal plane, on side rails. Lead blocks may easily and quickly be placed upon it to delineate a field already marked with ink upon the patient's skin. The beam may be varied at its periphery simply by raising or lowering an overlay above the table upon which the patient is lying, in conjunction with the use of lead overlay blocks. Since the device is movable in the horizontal plane, it may be readily shifted from one area of the body to the other

[1] Presented in Exhibit form at the Forty-fourth Annual Meeting of the Pennsylvania Radiological Society, Harrisburg, Penna., April 24–25, 1959; First Award, Therapy Section. Accepted for publication in April 1960.

[2] Oncologist and Chief of the Head and Neck Service, American Oncologic Hospital, Philadelphia, Penna.

[3] Director, Radiology Department, Misericordia Hospital; Associate in Oncology, American Oncologic Hospital.



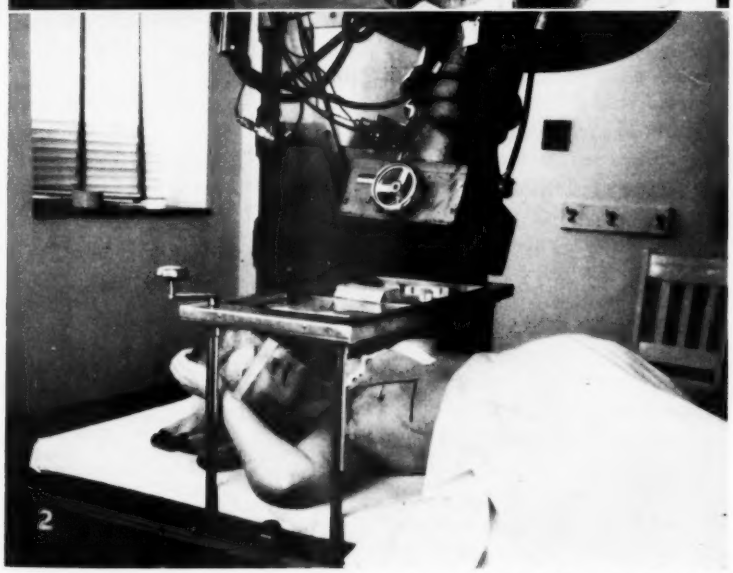


Fig. 1. Setting up a patient for treatment of an antro-ethmoid portal with field-shaping device.

Fig. 2. Patient in position for treatment of tangential chest-wall portal following mastectomy for carcinoma.

without moving the patient. It is easily and economically produced, sturdy in construction, and has proved to be efficient in operation. In use, the field-shaping apparatus is rolled on its side rails in order to place the platform over the treatment site. The target-skin distance is accurately gauged and adjusted. Our experience has been with a Van de Graaff static generator operating at between 1.7 and 2.0 megavolts. This unit was installed at the American Oncologic Hospital in 1948.

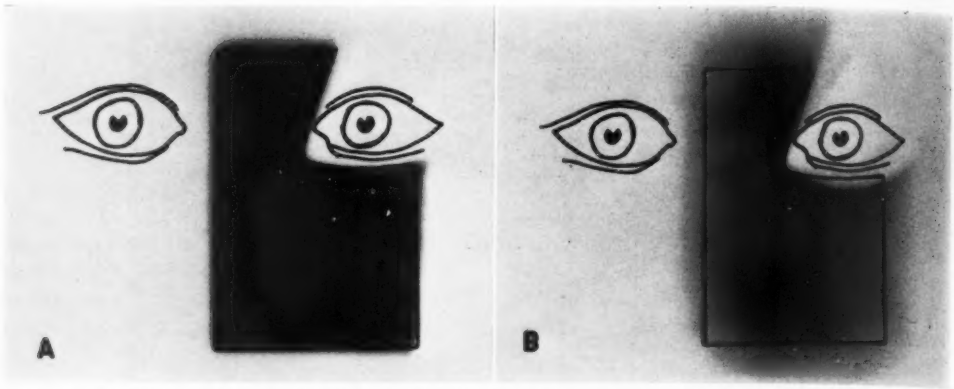


Fig. 3. Portal films of antro-ethmoid portal obtained by technic described here, superimposed on sketch of face. A. Note sharp limitation of beam and very small penumbra, with Van de Graaff unit. B. Note large penumbra with cobalt-60 unit. From Stanton (6).

A beam as much in conformity as possible with the portal which has been outlined on the skin is shaped with the integral field-shaping diaphragm which produces rectangular or square portals. An ordinary incandescent light localizer indicates on the skin the actual size of the treatment beam. Lead blocks (an inch or more in thickness) are now placed in such a way as to block out the portion of the beam, as shaped by the integral diaphragm, which extends beyond the marked portal. The lead blocks can be made in various sizes and shapes, such as segments of a circle, various bar-shaped pieces, squares, wedges, etc. The variety is limitless. These blocks are easily obtained by cutting into pieces ordinary lead sheeting of approximately 1 mm. thickness, stacking one above the other until a thickness in excess of 1 inch is reached. The stacked sheets of lead are then wrapped securely with adhesive tape and the resultant block is sprayed a neutral gray. These simply and cheaply constructed blocks last indefinitely. In our laboratory we still have many of the original blocks made over eight years ago.

Considerable ingenuity is occasionally required to shape the field properly. Skill develops with experience. Occasionally, by one means or another, in some areas, the blocks have to be placed three deep to produce the correctly shaped portal (see Fig. 1). After the first set-up, the subsequent daily set-ups are easily mastered.

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SUMMARIO IN INTERLINGUA

Un Dispositivo pro Formar le Campo, al Uso in Therapia Radiational a Undas Curte

Es describite un dispositivo que rende possibile que therapia radiational a portal micre, i.e. un typo de therapia que es currentemente applicate per medio de equipamento a orthovoltage a portas de conformation irregular, pote esser administrate con radios X de supervoltage o con apparatos a cobalt-60. Le dispositivo consiste de un platteforma a superficie de Lucite que es manovrabile tanto in le plano vertical (per gambas que es adjustabile) como etiam in le plano horizontal (per rails lateral). Blocos de plumbo es facile- e rapidemente placiate super illo pro delinear un campo jam marcate con tinta super le pelle del patiente. Le fasce pote esser variate a su peripheria simplemente per altiar o abassar un strato revestimentori supra le tabula occupate per le patiente, in conjunction con le uso de blocos revestimental de plumbo. Viste que le dispositivo es mobile in le plano horizontal, illo es facilemente transferibile ab un area del corpore del patiente al altere sin que le patiente mesme debe esser disrangiate.

An "All-Shape" Diaphragm for High-Energy Teletherapy Units[1]

ROBERT S. LANDAUER, Ph.D., HYO HYUN BYUN, M.D., and MARION F. MAGALOTTI, M.D.

IN CONVENTIONAL deep x-ray therapy the useful beam area to the skin is attained by cones or adjustable rectangular diaphragms modified, when desired, by strips or "cut-outs" of lead or lead rubber. With cobalt-60 therapy, because of the high energy of the gamma rays, such a modification does not offer sufficient skin protection, and, as a result, the portals are generally limited to square or rectangular shapes. Since it is desirable that therapy fields conform to the presenting pathological pattern, we have designed a simple, adjustable diaphragm which gives essentially any field shape. The variation in field shape is obtained by the manual adjustment of a number of lead plates, each $2 \times 6 \times 3/8$ inch thick. This adjustment can be made in less than a minute.

TABLE CONSTRUCTION

The lead plates and their supporting table are not connected in any way with the teletherapy unit but are positioned between it and the patient. The supporting table is constructed of $2 \times 1/4$-inch angle iron, and measures 44 inches long by 21 inches wide by 42 inches high. The table top is of 3/4-inch birch plywood with a 14-inch square hole cut in its center. The hole is rabbeted at its edges to accommodate a 15-inch square piece of clear Plexiglas 1/2 inch thick. The top of the Plexiglas is flush with the top of the table. A sheet of 1/4-inch-thick wired safety glass, 27×27 inches, is centered over the square of Plexiglas and serves as the surface upon which the lead plates slide.

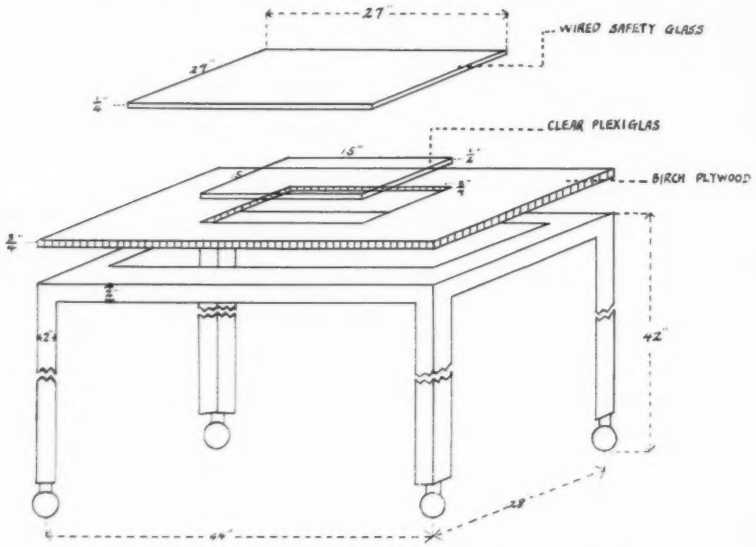

Fig. 1. Diagram of the supporting table for the "all-shape" diaphragm.

[1] From Cook County Hospital, Chicago, Ill. (R.S.L., Radiation Physicist; H.H.B., Senior Resident, Department of Radiation Therapy; M.F.M., Director, Department of Radiation Therapy). Accepted for publication in March 1960.

Fig. 2. The properly shaped plywood is being removed after the lead plates have been closed manually about its perimeter.

OPERATING PROCEDURE

The skin area to be treated is marked with a cotton-tipped applicator dipped into a solution of gentian violet. This marked area is overlaid with a piece of transparent celluloid or old film, and the marking is traced on the film with a wax pencil.

Since the diaphragm will be between the patient and the radiation source, its opening must be smaller than the tracing, in the ratio of source-skin distance to source-diaphragm distance. This reduction (in our particular case of 1.2 to 1.0) is accomplished by transferring the mark on the film to a piece of 1/4-inch plywood, with a pantagraph.[2]

The plywood, which has been marked by the pencil of the pantagraph, is cut to the marked shape with a power jig saw. The properly shaped plywood is placed on the glass, and the lead plates closed manually about its perimeter. The plywood is then removed, labeled with the patient's name, and preserved for each succeeding treatment of that patient (Fig. 2). It may be noted that the plywood and jig saw could be replaced by cardboard and a pair of scissors. Since the template will be used a number of times, however, it was felt that the additional labor involved in cutting the more durable plywood was well spent.

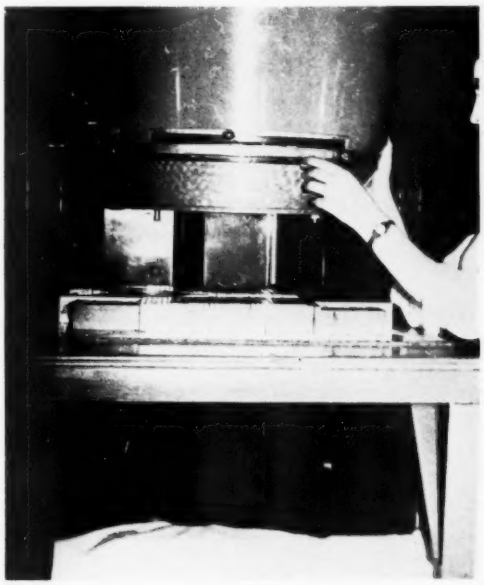

Fig. 3. The properly adjusted diaphragm is in place over the patient.

[2] Pantagraphs may be purchased for about $2.00 at most drafting-supply stores.

Additionally, the closure of the lead plates can be accomplished more readily around the plywood than is possible around relatively thin and flexible cardboard.

The properly adjusted diaphragm is wheeled over the patient in such a position that the light source from the therapy unit shows a shadow that coincides with the marked skin area (Fig. 3).

PHYSICAL FACTORS

The lead plates are an alloy of 90 per cent Pb and 10 per cent Sn. This alloy is both harder and smoother than pure lead. The number of lead plates is 120, and their weight approximately 230 pounds.

The percentage of the useful beam transmitted by the protecting lead plates is approximately 5 for Co^{60} gamma rays. The increase in treatment time due to attenuation by the glass window and the Lucite plate is 6 per cent for Co^{60} gamma rays.

ADVANTAGES PROVIDED

This device permits the use of fields of all shapes and lessens the number of fields required, thus decreasing the chance of overlapping. It also minimizes penumbra due to the short distance between the diaphragm and patient. It may be used with any teletherapy apparatus since it is not attached to the unit. Operation is simple with no electrical or mechanical features. The cost is slight. It is practically a "do-it-yourself" project.

DISCUSSION

While this apparatus can be employed for vertical beam therapy only, we do not feel that this is a significant disadvantage. Most of the patients for whom it is indicated can be treated lying down.

In the nine months that we have been using this diaphragm at the Radiation Center, we have seen no evidence of any unusual or abnormal skin effect which might be attributed to secondary x-rays or electrons originating in the diaphragm structure.

SUMMARY

A simple, inexpensive, manually operated lead diaphragm is described which provides practically any shaped field for use with cobalt-60 or other high-energy therapy units.

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SUMMARIO IN INTERLINGUA

Un Diaphragma Omniforme pro Apparaturas Teletherapeutic a Alte Energia

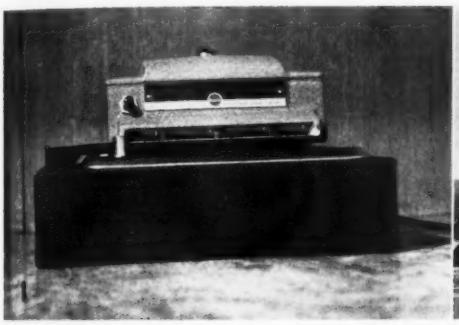
Es describite un simple, incostose, manualmente activate diaphragma de plumbo que provide campos de practicamente non importa qual conformation al uso con apparatos therapeutic a cobalt-60 o alteremente alti-energic. Le variation del forma del campo es effectuate per un numero de placas de plumbo que es supportate per un specialmente construite tabula completemente separate ab le apparato teletherapeutic. Le platta del tabula es de ligno contraplacate e ha un apertura de 14 pollices quadrate, coperite de plexiglas clar sub un spisse lamina de vitro de securitate a filo metallic. Le area a tractar es marcate super le pelle, e un replica de illo es facite ex ligno contraplacate que es ponite super le vitro. Le placas de plumbo es claudite manualmente circum le perimetro del ligno. Isto es removite (e preservate pro usos futur), e le tabula con le placas in position es rolate supra le patiente e adjustate de maniera que le lumine emanante ab le apparato therapeutic produce un umbra coincidente con le area marcate in le pelle.

Le procentage de fasce utile transmittite a transverso le placa de plumbo es approximativemente 5 pro radios gamma ab cobalt-60.

Automatic Time-Indicating Device for Use in Radiography[1]

IVAN M. WOOLLEY, M.D.

THE KNOWLEDGE of the time of day when a radiograph is made is a helpful, and frequently necessary, adjunct to accurate interpretation. In the past we have attempted to provide such information by requiring the technician to write the time in pencil upon the flash card used for photographic identification. This worked well when instructions were followed but there were frequent incidents when a technician would forget to record the time or neglect to change it on the card when a subsequent examination was made later in the day. In order to circumvent such errors, an automatic timing device was constructed and affixed to an Eastman identification printer.



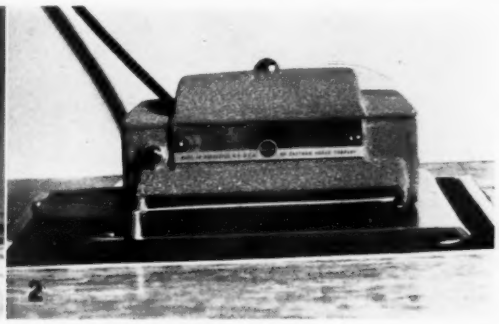


Fig. 1. Present model of automatic time indicator.
Fig. 2. Present model as it appears inserted into work counter.

Fig. 3. Time as indicated on film, 6:45 A.M.

The device consists of a small electric-clock motor so geared that the shaft makes one revolution each twenty-four hours. This shaft rotates a 3-inch disk made from a sheet of "Cronar" polyester film. Around the periphery of the disk are inscribed the time intervals in hours and half-hours, as on the face of a clock. An indicator is provided on the printer as a reference point.

The mechanism is installed upon the side of the identification printer in such fashion that a portion of the disk projects into the printer and lies beneath the flash card and above the film. It is also within the light beam area. The aperture made in the printer is of sufficient size to expose not less than two hourly designations, which is of assistance in reading the time on the finished film.

In order to provide an area of nonexposed film upon which to photograph these data, an extension to the usual lead blocker is affixed to the cassette. Cronar was selected as material for the disk because of its optical clarity, flexibility, and toughness, and because it is thin enough to prevent perceptible distortion. The flexibility and toughness prevent damage if the disk should for any reason be accidentally distorted.

This device affords a positive record of the time that the radiograph entered the developing process. While this varies somewhat with the time of actual exposure, the difference is of no practical importance.

[1] From Emanuel Hospital, Portland, Ore. Accepted for publication in February 1960.

When constructing the prototype, we employed the one- to twenty-four-hour system because we feared that the disk was too small for A.M. and P.M. designations. Since putting it into actual use, we have learned that there is adequate room for standard twelve-hour A.M. and P.M. lettering, and we propose to adopt that system in future instruments. The prototype has been in use in a busy department for six months and has thus far functioned without difficulty.

Aside from its obvious advantages in all types of serial studies, this device has proved its value as an automatic indicator of the time the patient was in the department. It also furnishes evidence of overloading of the department by nonemergency studies during off-hours, when it is staffed only for emergencies, and has been found useful in numerous other ways.

NOTE: We express our thanks to Mr. C. H. Morris, General Electric X-ray Co.; Mr. Hugh McClellan, Eastman Kodak Co.; and Mr. Fred Rogers of Dupont for their valuable suggestions and assistance in constructing the device.

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SUMMARIO IN INTERLINGUA

Un Horographo Automatic al Uso in le Radiographia

Information es frequentemente desirabile con respecto al tempore al qual un roentgenogramma esseva obtenite. Un dispositivo pro le registration automatic de iste detalio esseva construite e attachate al imprimitor de identificationes. Le dispositivo consiste de un micre motor electrochronometric, montate de maniera que su axe face un revolution in vinti-quatro horas. Iste axe causa le rotation de un disco de tres pollices de diametro talliate ex un folio de polyestere "Cronar." Circum le peripheria del disco, intervallos de tempore in horas e medie horas es inscribite como in le quadrante de un horologio. Le imprimitor es equipate con un indicator como puncto de referentia.

Le dispositivo es installate al latere del imprimitor de maniera que un portion del disco jace infra le usual carta matriculatori. Pro provider un area de non-exponite pellicula in que le identification del hora es photographate, un extension del usual blocator de plumbo es affixate al cassetta.

Effect of Hypaque on Mouse Peritoneum[1]

VERNON STERNHILL, M.D., and SOLOMON SCHWARTZ, M.D.

INCREASING popularity of water-soluble agents for examination of the gastrointestinal tract prompted an investigation of peritoneal reaction to Hypaque. There is a considerable, and, at times, controversial literature on barium contamination of the abdominal cavity (1–5). It was not our intention to confirm or deny any antecedent study but rather to compare the effects of instilling sterile saline, 25 per cent Hypaque, and barium into the peritoneal cavity of mice.

MATERIAL AND METHODS

Initial experiments indicated that 2.0 c.c. of fluid was the maximum volume that could be safely instilled into the peritoneal cavity of the mouse. Intraperitoneal injections were made of 0.5, 1.0, and 2.0 c.c. of sterile saline, Baroloid,[2] and 25 per cent Hypaque. Just prior to the experiment, the proprietary preparations were freshly mixed: to 180 c.c. of tap water 3.5 ounces of Baroloid were added; to 100 c.c. of tap water, 25 grams of powdered Hypaque, making a 25 per cent solution. There were 30 mice in each group, permitting sacrifice in pairs at the end of one, six, twenty-four, seventy-two hours, and one week. Cultures were made of all utensils and of the media prior to injection, and of the peritoneal cavities at the time of sacrifice.

On sacrifice, sections were taken of the liver, spleen, kidneys, and the peritoneal surface. The latter is such a tenuous structure in mice that a section of diaphragm with its peritoneal covering was found best for study. Viscera were obtained for study of reaction on visceral peritoneum.

RESULTS

A. Culture: Every attempt was made to insure, so far as possible, that any peritonitis following injection was the result of the agent itself and not of organisms introduced. Prior to injection cultures were made of Baroloid and of Hypaque to see whether or not these agents harbored organisms or had any bacteriostatic action. Baroloid routinely harbored *B. subtilis* and supported growth of *E. coli*. Hypaque was consistently sterile and supported growth of *E. coli* for six hours. Cultures taken at twenty-four hours and later were sterile. A latent bactericidal action may therefore be claimed for Hypaque. In addition, cultures were made from the tap water used and of the various mixing appliances employed. Tap water was sterile but the utensils harbored various *Staphylococci*, none of which were gastrointestinal pathogens. With a few exceptions that may have been due to contamination, organisms recovered from

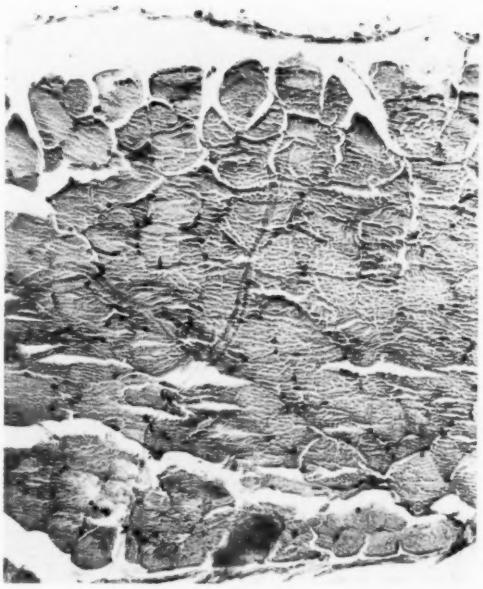

Fig. 1. Section of diaphragm with normal peritoneal covering. Saline control.

[1] From the Department of Radiology, Jewish Hospital, Brooklyn, N. Y. Accepted for publication in May 1960.

[2] Bell-Craig colloidal barium.

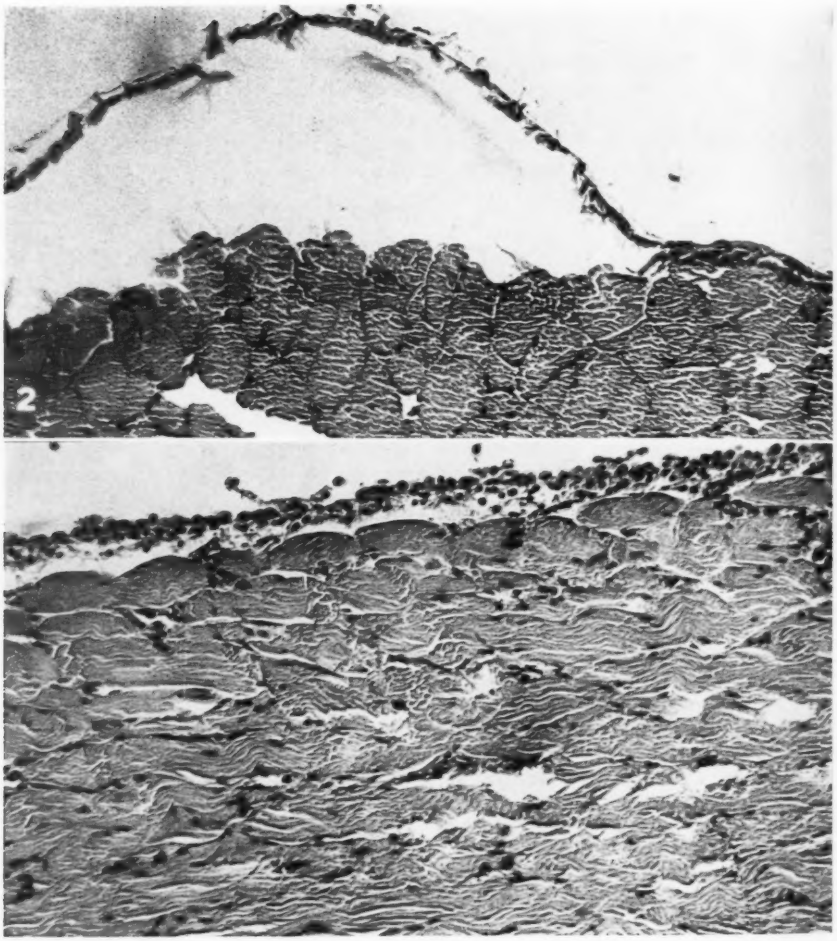

Fig. 2. Section of diaphragm seventy-two hours after injection of Hypaque. No peritoneal reaction.
Fig. 3. Section of diaphragm seventy-two hours after injection of Baroloid. Mild peritoneal reaction.

peritoneal cavities were identical with those present in the agent prior to injection. A few animals died prior to the time set for sacrifice. Their peritoneal cavities were grossly contaminated, suggesting bowel puncture during injection. All peritoneal cavities of mice sacrificed one week after injection were sterile, pointing to the ability of mouse peritoneum to cope with organisms introduced and, more important, indicating that the peritoneal reaction found was chemical and not bacterial.

B. Peritoneum: No significant peritoneal reaction resulted from saline or Hypaque injections. Baroloid uniformly evoked an inflammatory reaction not related to volume but progressively more severe with the passage of time. These findings are illustrated in Figures 1 to 5.

DISCUSSION

This experiment demonstrates that Hypaque and probably other water-soluble agents are not irritating to the peritoneal cavity of mice. This observation should

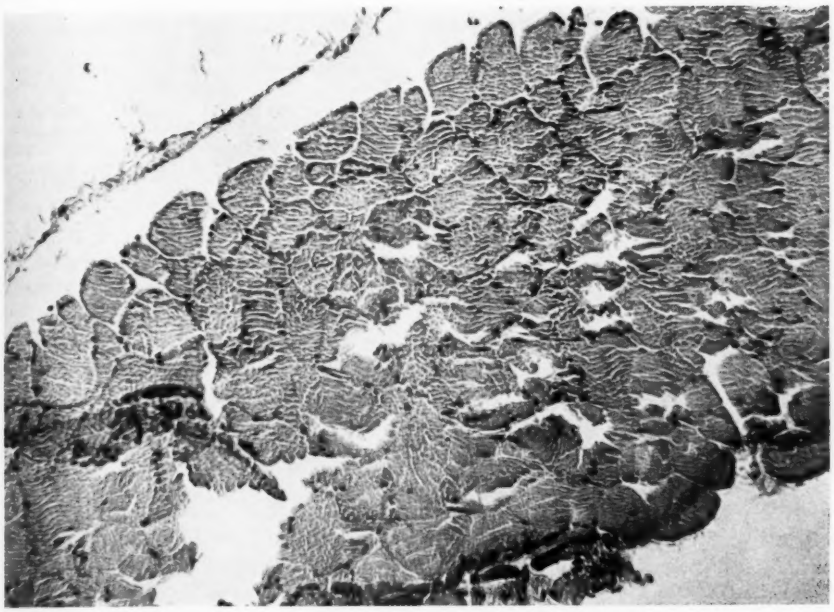

Fig. 4. Section of diaphragm one week after injection of Hypaque. No peritoneal reaction.

not, however, be interpreted as affording *carte blanche* to spill such agents into the abdominal cavity through gastrointestinal perforations. There is ample evidence to show the dangerous effect of gastric or intestinal content (2, 5). While a bactericidal effect on *E. coli* has been attributed to Hypaque in this study, it can hardly be considered an effective antibiotic, nullifying the dangers inherent in gastrointestinal perforation. To study this point, mice were injected with a Hypaque and feces mixture and sacrificed at one, six, and twenty-four hours. Controls injected with Hypaque only were sacrificed at the same time. All controls had sterile cavities, whereas all injected with the feces-containing mixture showed gross contamination at the time of sacrifice or at the time of earlier death. The clinical possibility of gastrointestinal perforation remains a contraindication to opacification with any agent.

The lack of reaction to Hypaque would suggest that it is, from this point of view, ideally suited for hysterosalpingography, where peritoneal spillage is desirable. Further, it is doubtful that a sterile preparation would need to be used.

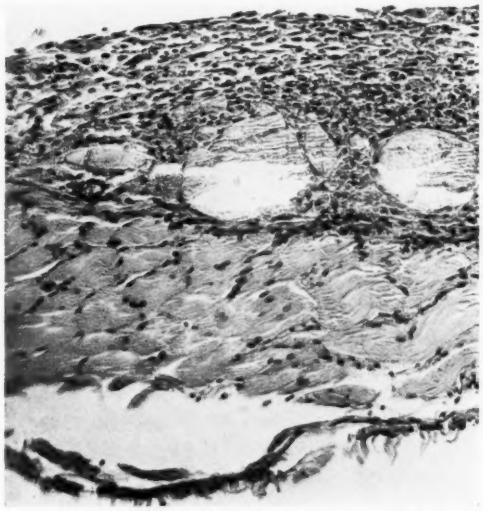

Fig. 5. Section of diaphragm one week after injection of Baroloid. Marked peritoneal reaction with deposition of Baroloid crystals.

SUMMARY

An experiment is reported in which saline, Baroloid, and Hypaque were in-

jected into the peritoneal cavities of mice. Chemical peritonitis was produced only by the barium.

ACKNOWLEDGMENT: The authors express their gratitude to Dr. Frederick Traub and Miss Mildred B. Walker of the Department of Microbiology, to Dr. David Grayzel, Dr. Abraham Mackles, and Miss Freda Strauss of the Department of Pathology, and to Dr. Ruth Kaslow of the Department of Animal Research, of the Jewish Hospital, of Brooklyn, without whose untiring efforts this study would have been impossible.

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SUMMARIO IN INTERLINGUA

Le Effecto de Hypaque in le Peritoneo del Mus

Es reportate un experimento in le qual solution salin, Baroloid, e Hypaque esseva injicite in le cavitates peritonee de muses. Peritonitis chimic esseva inducite solmente per le preparato de barium. Hypaque non irrita le cavitate peritonee del mus. Le mesmo vale probabilemente etiam pro altere agentes hydrosolubile. Le possibilitate clinic de perforation gastrointestinal, con le resultante passage de contento gastric o intestinal a in le peritoneo, remane nonobstante un contraindication contra le introduction directe de agentes de opacification del vias alimentari.

Le absentia de un reaction peritonee pare favorar Hypaque como medio ideal in hysterosalpingographia ubi un escappamento peritonee es desirabile.

Some Biomedical Problems of the Nuclear Age[1]

CHARLES L. DUNHAM, M.D.[2]

THE NUCLEAR AGE has served to magnify the health problems which were already apparent as a result of the increasing use of radium and x-rays in medicine, in industry, and in research. It has intensified public interest in these problems to the point of genuine concern over the total impact of the increased exposure of the population to radiation on the incidence of leukemia, on the average life span, and on our genetic constitution. I shall try to bring you up-to-date on the current status of some of these problems and on the present trends in research effort. I will further point up areas where greater effort is needed.

The problems to be discussed fall into three principal categories. The first category concerns the definition of the dose and the dose-rate relationships which exist between radiation exposure and biological effects. The second concerns the relationship between the concentration of a given radioelement in the environment (air, food, and water) and the resultant exposure to any given organ of the body. The third concerns the development of effective prophylaxis and treatment of whole-body and local radiation injury. A fourth —in which I for one fail to see even a glimmer of hope at the present time—I shall touch only briefly. It concerns our inability to relate unequivocally a given case of cancer, leukemia, gene mutation, or a shortened life span to radiation as the causative agent. There are no tags on cancer that say this one was caused by radiation, and that one by cigarette smoking, while another was the result of a specific chemical carcinogen or of hormonal imbalance, or some hereditary factor. The same is true, of course, for gene mutations. This situation as regards neoplasia is likely to plague us more and more as time goes on. With radiation burns, on the other hand, there is no such problem. The histopathology is quite characteristic. Even with neutron-induced "radiation cataracts" we are not too badly off, as there is a fair quantitative relationship between neutron dose and cataract formation, and the cataracts have certain morphologic features which, though not absolutely unique, are quite characteristic.

The first problem is the one which is eliciting the most interest today, namely, the relationship between dose and dose rate and biological effect.

Let me begin this discussion of the biological effects of radiation by stating that, in spite of the many gaps in our knowledge of radiation effects in man, we have a greater body of knowledge of the dangers associated with radiation than of any other industrial or general environmental hazard from toxic materials. Dr. Detlev W. Bronk, in his foreword to the 1956 NAS-NRC Summary Report, *The Biological Effects of Atomic Radiation* said: "The use of atomic energy is perhaps one of the few major technological developments of the past fifty years in which careful consideration of the relationship of a new technology to the needs and welfare of human beings has kept pace with its development. Almost from the very beginning of the days of the Manhattan Project careful attention has been given to the biological and medical aspects of the subject. By contrast, the automobile revolutionized our pattern of living and working, but we are only now beginning to appreciate the problems of safety, urban congestion, nervous tension, and atmospheric pollution which have accompanied its development."

Since the successful achievement of the

[1] Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15-20, 1959.

[2] Director of Division of Biology and Medicine, U. S. Atomic Energy Commission.

release of nuclear energy, a relatively small number of persons have been accidentally overexposed to radiation in our atomic energy program, and three deaths are directly attributed to accidents involving radiation among the tens of thousands who have worked in this program. Compared with the first large-scale uses of lead, beryllium, and aniline in industry, the record is remarkably good.

For most toxic materials our knowledge today is comparable to that which existed in the late twenties and early thirties about radiation hazards. The situation with radiation at that time was about as follows:

Amounts of high-intensity radiation which would be immediately fatal, amounts which would have a high probability of producing readily demonstrable permanent injury or cancer in the irradiated tissue, and amounts which would temporarily or permanently damage the blood-forming organs were known to within a factor of a few. It was also known, in a general way, what total dose from repeated exposures to radiation would have a high probability of inducing skin cancer and depression of bone-marrow activity. In the case of radium deposited in the skeleton, the amounts with a high probability of producing bone cancer in adults were pretty well understood. On the other hand, the amounts of radiation incurred at a high dose rate which would give a probability of producing only one case of leukemia or one case of bone cancer in a population of say 10,000 individuals so irradiated were undetermined. Information on this point had not been sought. The dose of low-intensity radiation required to produce such effects was equally unknown. The amounts of relatively high-intensity radiation to the fetus given at an appropriate time during gestation which would regularly produce gross developmental defects were appreciated and the amount which would produce a given number of point mutations in the fruitfly was rapidly becoming established as a result of the researches of Hermann Muller.

For most toxic substances our knowledge is limited to the acutely fatal dose, and the chronic exposure dose which has a relatively low probability of leading to readily demonstrable chronic effects, albuminuria, leukemoid reactions, aplastic anemias, gingivitis, encephalopathy, pulmonary fibrosis, and cancer of one sort or another, as the case may be. The realm of possible genetic and developmental defects is largely unexplored save for a few substances such as the nitrogen mustards and colchicine. There have been no studies attempting to determine whether or not there is a given exposure rate or even a single dose of some chemical constituent of motor exhaust fuel, for example, which would in time produce one additional case of leukemia or lung cancer per ten thousand persons so exposed.

With radiation today we are on pretty firm ground in estimating the probable number of additional cases of leukemia, or gene mutations, or average curtailment of life span to be expected in a population exposed to high-intensity whole-body irradiation in increments of 50 r or greater. The factor or factors which determine which individuals get leukemia and which do not under such circumstances are totally unknown.

Radiobiological research is concentrating more and more on defining the response in terms of neoplasia, life span, and genetic effects to low-beam intensity or low body burden exposures, and interrupted relatively high-beam intensity exposures of short duration at various ages in sizable populations of animals.

A few decades ago it was tacitly assumed that, with the possible exception of genetic effects, there was a radiation dose below which no permanent injurious effect would be incurred, even in exceptional individuals. In the past few years this concept has come under extremely close scrutiny, and while it has not been altogether abandoned it has been realized that the burden of proof lies with its proponents. With extremely high-intensity mixed

gamma neutron irradiation, the studies of the Atomic Bomb Casualty Commission in Japan indicate proportionality of leukemia induction with doses down to about 50 or 100 r. Unfortunately the true exposures of the surviving population in Nagasaki and Hiroshima are not very precisely known, so that the effect at lower doses cannot be determined. Work like that of Dr. Victor P. Bond and associates at the Brookhaven National Laboratory has shown a true proportionality with doses as low as 25 r for mammary neoplasia in one strain of rat.

Abundant data indicated that for lethal mutations induced in *Drosophila* spermatozoa there is a linear relationship from 13,000 r down to 25 r, that the mutation rate is independent of intensity, and that the relative biological effectiveness decreases with increasing linear energy transfer of the radiation. These experimental facts strongly suggest that formation of a single ion pair is the unitary event which leads to the induction of a mutation and, hence, that all radiation absorbed in the genetic material, regardless of dose or dose rate, is fundamentally mutagenic.

Earlier work by Lorenz and associates and recent work in this country and in England with continuous exposures at dose rates of a few tens of r down to 1 r or less per week have shown either a lesser effect, or in some instances no apparent effect, in terms of curtailment of average life span, leukemia, or tumor induction, when compared with the effect of comparable total doses at relatively high dose rates. The findings at these dose rates (2 r per week is roughly one thousand times that incurred from natural or background radiation) suggest that there may indeed be, from a practical standpoint, a threshold for some of these effects, or that at the worst the effect is very greatly reduced. Perhaps this results from repair of the damage by metabolic or proliferative activity of the cells.

In the field of genetic effects the recent work of the Russells at the Oak Ridge National Laboratory has shown a similar but less dramatic reduction in effect at dose rates of about 15 r per day. The effect seems to be proportional to the total accumulated dose but is roughly one-fourth that observed at the relatively high dose rates used in prior acute exposure studies.

Meanwhile, as Dr. E. B. Lewis has pointed out in his written testimony submitted to the May 1959 Joint Committee on Atomic Energy Fallout Hearings, we have the problem of the possibly greater sensitivity of the very young and of the developing fetus to resolve. Excepting studies of acute whole-body injury most studies in the past have utilized young adult animals.

So it can be said that refinements in our knowledge of dose-rate relationships and age of exposure are imperative needs for those concerned with assessing the significance of current and proposed basic radiation protection standards. This information can be obtained with some reasonable degree of certainty in a variety of experimental animals at dose rates of about 1 r per week or greater. For dose rates equivalent to or less than background, the number of animals needed for a first-rate well controlled experiment would be in the millions for a single experiment. Scientists are unlikely to undertake studies of this magnitude in the near future even if facilities were to become available to them.

Two other possible approaches present themselves. It goes without saying that if we understood all the mechanisms involved in the production of radiation effects, we would know the answer to our problem. Consequently, the AEC in its biomedical research program is attempting to foster and strengthen research efforts in the field of energy transfer and in what might be called molecular biophysics as it may relate to ionizing radiation effects.

The other possible approach is to seize on natural situations where populations have been subjected to naturally occurring

radioactivity several-fold that which is the rule, and search for evidence of somatic or genetic effects which might be attributable to these radiations. This approach is most difficult. Finding a truly comparable control population, and determining the average exposure of the high-exposure populations are two obvious difficulties. Nevertheless, I believe such studies should be undertaken whenever the circumstances are at all favorable. They should be pursued with care to assess the total health of the group under study so that even though the question asked in terms of radiation effects may not be satisfactorily answered, the information developed in the study will be useful for other purposes.

So much for the scientific data on which all attempts to set basic standards of radiation exposure must be based.

The second category of problems concerns the equally wide gaps in our knowledge of the relationships between chronic exposure to given concentrations of particles of radioactive material in the air and the eventual concentration of these materials in specific organs of the body. Observations on uptake, deposition in, and movement out of one organ into another one are complex matters requiring greatly intensified study under rigidly controlled conditions. This sort of work is painstaking and costly but it must be done with a variety of radioelements in a variety of chemical forms if we are to be on really firm ground in assessing the industrial hazards associated with dealing with the longer-lived radioisotopes. Work already under way will before long firm up the relationship of the radium content of water and the eventual body burden of radium. The same can be said for strontium-90 in the diet.

As to the prophylaxis and treatment of manifest radiation injury the work on radiation burns of the skin has been sterile. Here we have a situation crying for ideas as to how, other than by resorting to surgical excision, we can cope with the chronic stage which in man may last ten or twenty years before malignant change becomes manifest.

Pre- and post-irradiation therapy of acute whole-body irradiation injury in the experimental animal continues to yield exciting results. The status of the application of these technics to human cases, though improved, is uncertain. AET and related compounds in the forms commonly used experimentally as prophylactic therapy appear to be too toxic in man to be life saving. One area not yet adequately explored is whether or not more modest doses given in advance of an exposure from which recovery would probably occur anyway would suppress to any useful extent the delayed effects of the acute injury.

Infusions of homologous human bone marrow have come in for a great deal of publicity since their use in the fourth week following the accidental exposure of persons to several hundred rads at the Yugoslav reactor at Vinca. Mathé, who treated these patients in Paris, is convinced that these cases demonstrate the efficacy of homologous marrow as a promoter of rapid recovery in the peripheral blood. Not everyone agrees with this, however. The question has been raised as to whether or not the prompt recovery at that particular time in the course of the syndrome would not have occurred spontaneously. Nevertheless, Mathé has used marrow relatively late in cases of moderately severe whole-body irradiation injury with no untoward effect and with apparent favorable response. It is uncertain at the present time whether homologous marrow is life saving and without unfavorable delayed reactions in persons receiving 700 or 800 or more rads of whole-body irradiation. Meanwhile the search goes on for the cell, the cell component, or even a possible humoral factor which can stimulate recovery of marrow seriously injured by acute exposure to ionizing radiation.

In summary, in the past seventeen years we have come a long way in our knowledge of radiation injury and have even de-

veloped promising leads on how to ameliorate it. Without in any way disparaging those who have contributed that knowledge, it is only fair to say that the knotty unsolved problems which I have touched on today pose at least as great a challenge to the ingenuity and patience of the radiation biologist, the radiological physicist, and the molecular biophysicist.

Division of Biology and Medicine
U. S. Atomic Energy Commission
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SUMMARIO IN INTERLINGUA

Alicunes del Problemas Biomedical in le Etate del Nucleos Atomic

Le problemas sanitari associate con le etate del nucleos atomic se divide in tres major categorias. Le prime concerne le definition del dosage e del relationes de dosage e intensitate que existe inter le exposition al radiation e le effectos biologic. Le secunde concerne le relation inter le concentration de un radio-elemento particular in le ambiente (aere, alimento, aqua) e le resultante exposition de un organo particular del corpore. Le tertie concerne le disveloppamento de efficace methodos prophylactic e therapeutic in lesiones radiational del corpore total o de importantia local. Le stato currente de iste problemas es evalutate. Es signalate le areas que require un plus concentrate effortio.

Visualization of Renal Parenchyma by Scintiscanning with Hg^{203} Neohydrin[1]

JOHN G. McAFEE, M.D., and
HENRY N. WAGNER, Jr., M.D.

Radioactive contrast media, such as I^{131}-labeled Diodrast, Miokon, or Hippuran, have been widely used for renal function studies. They are entirely unsatisfactory, however, for renal scintillation scanning because they are rapidly excreted by the kidneys, without retention in the renal parenchyma (Fig. 1, A). In contrast, mercurial diuretics labeled with radioactive mercury are concentrated to a high degree in the renal tubular cells (2), chiefly in the cortex, prior to their appearance in the urine (Fig. 1, B). Furthermore, the nuclide Hg^{203} has a single, rather weak gamma emission (280 kev) that enables good resolution when a multihole focusing collimator and gamma spectrometry are used (1). These pharmacological and physical characteristics make it possible to obtain a clearly delineated spatial image of the kidneys in man by means of scintillation scanning.

The mercurial diuretic is retained in the renal parenchyma long enough to permit completion of the procedure. The effective half-life of the compound within the body is nevertheless quite short (average, three hours), so that the radiation dosage is minimal (less than 0.5 rad), despite the long physical half-life of Hg^{203} of forty-five days.

Following an intravenous dose of 100 to 150 microcuries of Hg^{203} Neohydrin, maximum renal concentration usually occurs within one to two hours. The scanning procedure is performed with the patient prone, to minimize the detector-to-kidney distance.

In a preliminary trial of this procedure in 25 patients, a good image of the renal parenchyma has always been obtained in the absence of uremia. In several instances of mild uremia (serum urea nitrogen 40 to 80 mg./100 c.c.) the size and shape of the kidneys have been demonstrated when intravenous pyelography has shown no visualization. When the uremia has been more severe, the labeled diuretic concentrates in the liver as renal concentration becomes poorer. Space-occupying lesions within the kidney, both cysts and tumors, have been demonstrated as filling defects (Fig. 2). The method has proved valuable in differentiating fetal lobulations distorting the renal margins from true intrarenal masses. Polycystic renal disease has produced a picture not only of generalized kidney enlargement, but the cysts have been apparent as multiple filling defects. A great potential of this method may

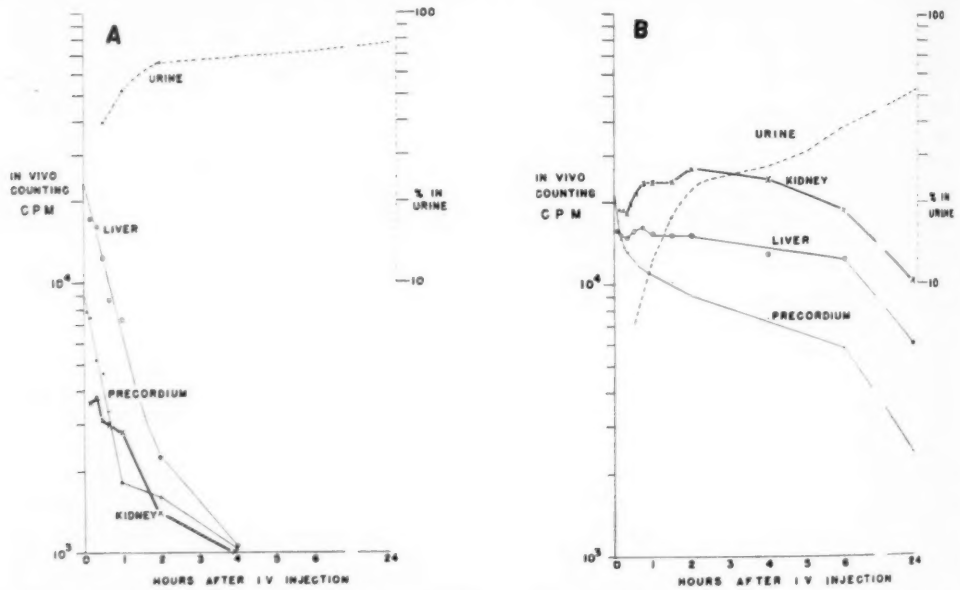

Fig. 1. Distribution and excretion of 20 μc of radioactivity in a normal subject. A. I^{131} Diodrast. B. Hg^{203} Neohydrin. Note the high count rate over the kidney at one to two hours. Urinary excretion is somewhat slower than for I^{131} Diodrast.

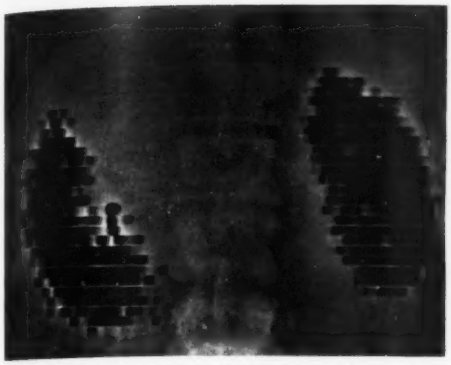

Fig. 2. Bilateral renal scintiscan superimposed on abdominal radiograph. A localized area in the right upper kidney failed to concentrate the Hg^{203} Neohydrin, due to hypernephroma.

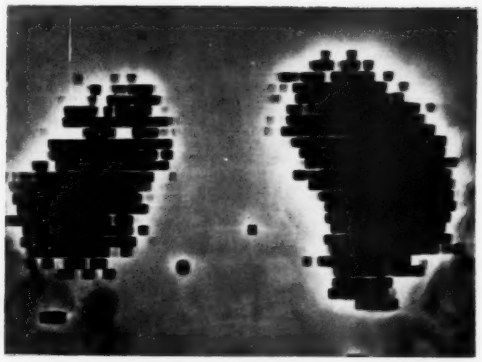

Fig. 3. Right renal scintiscan image smaller than that on the left. Decreased activity is seen in the right upper pole, as a result of localized ischemia with infarction.

be the demonstration of localized areas of renal ischemia. In two patients, ischemic renal segments have been revealed which were not clearly discernible by pyelography.

With anticipated improvements in resolution, it is hoped that space-occupying lesions or ischemic areas as small as 1.5 cm. in diameter may be demonstrated within the kidneys by the scanning technic. Resolution may be further improved by using a nuclide with an even weaker gamma emission. Co^{57}-labeled Versenate concentrates in the renal parenchyma and promises to be satisfactory for this purpose.

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[1] From the Diagnostic Radioisotope Laboratory, The Johns Hopkins Hospital, Baltimore, Md.

EDITORIAL

The Editor's Responsibility

The responsibility of the medical editor covers ultimately all the material which goes into the publication carrying his name: scientific articles, editorials, book reviews, announcements, and abstracts if these are included in his journal. In some instances, it is true, he may delegate his responsibility for some of these divisions to others and in the overall picture a host of associates give loyal and devoted service with little public commendation for their efforts. But, just as he receives credit for much that is contributed by others, so must he be prepared to accept adverse criticism of all published material. The final responsibility remains in his hands.

It has been estimated that over 7,000 medical journals are being published today and we may look to see this number significantly increased year by year. Many of these, to be sure, are highly specialized, but to keep wholly abreast of the literature of even a single specialty places a severe tax on the mental and physical powers of most physicians.

It becomes one of the first responsibilities of the editor, therefore, to scrutinize every paper submitted for publication with the utmost care; to see that it presents a worthwhile observation, either developing a new subject or providing new light on an old one. The day has passed when material which is freely available in standard textbooks is acceptable for publication in current journals unless it includes confirmatory evidence concerning conditions of previous uncertainty.

A second editorial responsibility is the limitation of papers to a reasonable length. The need for shortening scientific papers has been voiced repeatedly by medical editors, but the results have been negligible. In an editorial in RADIOLOGY Hewitt (3) gave much good advice to authors on this subject. He warns especially against the fault of the medical writer who, having told of his purpose, material, method, and results, must tell of them again under the headings "Comment," "Summary," and "Conclusions," thus writing his paper four times instead of once. The advice of Alvarez (1) on this same subject is invaluable. He cautions the writer to mention only those essentials in the past history of his case or cases which contributed to the diagnosis and to omit all extraneous details, which succeed only in boring the reader.

"A good writer," says Alvarez, "edits his writings as ruthlessly as he would those of a stranger." Since, unfortunately, not every author falls within this classification, it may become the lot of the editor to call to his attention the requirements of a satisfactory presentation. Some of these may be summarized here.

First of all comes an attempt to captivate the interest of the reader. The title, therefore, is of the utmost importance, it should be as short as possible and yet indicate the contents of the article. It should also be so worded that the main theme is apparent and can be indexed correctly for future workers in the same field.

The opening paragraph is crucial if the writer is to hold the interest of the reader after having captured it with his title. It should state briefly the object of the paper and what new material is to be contributed. The subject matter should then be developed in a logical manner with a complete but concise account of the author's findings.

Long discussions of the previous literature and extensive quotations will prolong the article and kill the reader's

interest. It may serve the purpose equally well to refer to some previous publication which adequately summarized the earlier work on the subject. Those who are interested will then know where to look and others will be spared wading through pages which are of no concern to them. Since it is the positive findings that are of primary concern, these should be clearly stated and their significance indicated. Theorizing on the basis of unproved implications is to be avoided. If later work proves such theorizing invalid, the author's reputation will not be enhanced; if his theories prove correct, he will almost certainly receive credit for his observations.

It is the responsibility of both author and editor to see that a paper is written clearly, in simple easily understood English, with avoidance of the jargon which is intelligible only to certain specialties. The medical slang and abbreviations that are so freely used in the routine history have no place in formal medical literature. A scattering of polysyllabic words of uncommon usage may possibly give some readers the impression of scholarship but they are more apt to prove an annoyance. The well remembered works of English literature have been those in simple prose.

The matter of statistics places another responsibility on the shoulders of the editor. Carelessly assembled figures should arouse his suspicion. The physician who undertakes to produce a paper dealing largely with statistics is well advised to have them checked by an experienced statistician. There is little material that is capable of such distortion or productive of so much bewilderment as complicated statistics. It is doubtful, indeed, if the average reader will take the time to study them, and different persons are quite likely to draw different conclusions from them, unless they are well documented and to the point.

The Summary is an important part of a contribution in these days of overfilled time and an expanding literature. It should contain a brief statement of what is in the article, but no new material. The important points which are made in the body of the paper should be concisely stated, since many will read only the Summary, while others may be influenced by it to peruse the text in full. Indeed, the editor may find it a reliable guide in determining the suitability of the material for his particular journal.

Finally, the bibliography should contain references only to papers having a direct bearing on the subject and which the writer has actually consulted. References taken from abstracts and or quoted from others may lead to inexcusable inaccuracies, which are too often perpetuated in subsequent contributions to the subject.

Bjørneboe (2) in an excellent article has asked the question: "What can an editor do when he has received a manuscript which does not fulfil all his demands?" There are several obvious possibilities. The easiest course is to reject it immediately, and this may be necessary if the article contributes nothing new, if it is unsuitable for the journal to which it has been submitted, or if it will require a disproportionate amount of valuable publication space. Frequently, however, a poorly written paper may contain material of real worth, in which event the editor may offer his suggestions for altering the manuscript according to the standards of his journal. It has been the experience of the present writer that such suggestions are usually warmly welcomed and the article, having been revised accordingly, may upon resubmission require only a few simple changes by the editorial staff to make it acceptable for publication and a source of justifiable pride to the author. Sometimes shortening a paper may solve the problem and it will be found to gain emphasis by the omission of irrelevant details and long theoretical discussion.

So far we have limited our discussion to the editor's responsibility for scientific contributions which make up the bulk of the journal. His responsibility, as stated above, extends to other matters as well.

The Editorials are, of course, his special concern, whether they are his own or the contribution of others. He must be sure that the Announcements concern matters of general interest and are not merely disguised advertisements. The Book Reviews must be kept concise and informative. Abstracts present a double responsibility. Articles for abstracting must be wisely chosen and the greatest of care must be exercised to keep strictly to the meaning of the original. Errors here are doubly serious—to the writer of the paper and to the reader.

The meeting of these responsibilities is no light task. Their fulfilment in adequate measure is peculiarly rewarding.

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SECTION ON RADIOLOGY, CONNECTICUT STATE MEDICAL SOCIETY

The following officers were elected at a recent meeting of the Section on Radiology of the Connecticut State Medical Society: President, Ralph J. Littwin, M.D., Bristol; President-Elect, John Burbank, M.D., Meriden; Secretary-Treasurer, Wayne P. Whitcomb, M.D., Hospital of St. Raphael, New Haven. John H. Woodruff, M.D., of Hartford, Dudley B. Blossom, M.D., of Greenwich, and Fred J. Fagan, M.D., of New London, were elected to the Executive Committee for terms of three years, two years, and one year, respectively.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY

The Detroit Roentgen Ray and Radium Society announces the election to office of Fred K. Wietersen, M.D., President; William R. Eyler, M.D., President-Elect; Kenneth L. Krabbenhoft, M.D., Harper Hospital, Detroit 1, Secretary.

NEW MEXICO ASSOCIATION OF RADIOLOGISTS AND PATHOLOGISTS

Newly elected officers of the New Mexico Association of Radiologists and Pathologists are: President, Thomas Chiffelle, M.D., Albuquerque; Vice-President, Martin Goodwin, M.D., Clovis; Secretary-Treasurer, George C. Chaney, M.D., 801 Encino Place, N. E., Albuquerque; Corresponding Secretary, E. K. Neidich, M.D., Memorial General Hospital, Las Cruces.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY

The Northeastern New York Radiological Society has recently elected to office Everett A. Jacobs, M.D., Hudson, President; James A. Glenn, Jr., M.D., Glens Falls, Vice-President; Lester I. Citrin, M.D., St. Mary's Hospital, Troy, Secretary-Treasurer.

The Society meets in the Albany area on the second Wednesday of October, November, March, and April. The annual meeting is held in May or June.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

At the recent annual meeting of the Rocky Mountain Radiological Society, new officers were elected as follows: President-Elect, Thomas J. Kennedy, M.D., Denver, Colo; First Vice-President, John F. Bacon, M.D., Ames, Iowa; Second Vice-President, Marcus J. Smith, M.D., Santa Fe, N. Mex.; Secretary-Treasurer, John H. Freed, M.D., 4200 East Ninth Ave., Denver 20, Colo.; Councilor to the American College of Radiology, Ralph C. Moore, M.D., Omaha, Nebr. Grant P. Raitt, M.D., Billings, Mont., was elected to the Executive Committee, and Galen M. Tice, M.D., Kansas City, Kans., to the Program Committee.

The next annual meeting will be held in Denver at the Denver Hilton Hotel, Aug. 10–12, 1961.

SOUTH CAROLINA RADIOLOGICAL SOCIETY

Newly elected officers of the South Carolina Radiological Society are: President, William A. Matthews, M.D., Rock Hill; Vice-President, J. Harvey Atwill, Jr., M.D., Orangeburg; Secretary-Treasurer, George W. Brunson, M.D., 1406 Gregg St., Columbia.

SEVENTH INTERAMERICAN CONGRESS OF RADIOLOGY

The Seventh Interamerican Congress of Radiology will be held at São Paulo, Brazil, Sept. 3–9, 1961. The official themes of the Congress will be: Radiodiagnosis—Contrast Vascular Radiology; Nuclear Medicine—Medical Applications of Radioactive Iodine and Marked Iodine Derivatives; Radiotherapy—Supervoltage. Seminars and symposia will cover a wide range of subjects.

Further information may be obtained from the Secretary of the Congress, Rua Marconi, 94–2° andar, São Paulo, Brazil.

SOCIEDAD CHILENA DE RADIOLOGÍA

New officers of the Sociedad Chilena de Radiología are: President, Armando Doberti, M.D.; Secretary, J. P. Velasco, M.D., Avenida Santa María 0410, Santiago, Chile.

SOCIEDAD MEXICANA DE RADIOLOGÍA

The Sociedad Mexicana de Radiología has elected the following officers for 1960–61: President, José Manuel Falomir, M.D.; Secretary-General, E. Alvarez Hernández, M.D.; Secretary of the Minutes, Rodolfo de Castro, M.D.; Treasurer, Baudelio Villanueva, M.D. The address of the Society is Coahuila 35, Mexico 7, D. F.

AMERICAN REGISTRY OF X-RAY TECHNICANS

On Aug. 18, 1960, the new home of the American Registry of X-ray Technicians in Minneapolis,

Minn., was formally dedicated. Earl E. Barth, M.D., President of the American College of Radiology, Marjorie C. Tolan, R. T., President of the American Society of X-Ray Technicians, Chester H. Warfield, M.D., President of the Board of Trustees of the Registry, and Dr. A. N. Taylor, Secretary of the Council on Medical Education and Hospitals, A.M.A., participated in the dedicatory exercises.

The American Registry of Radiological Technicians (now A.R.X.T.) was established in 1922 through the efforts of members of the Radiological Society of North America and the American Roentgen Ray Society, to adopt standards for the certification of qualified technicians. In 1925 the Board of Directors of the Society of X-Ray Technicians took action determining that only registered technicians would be eligible for membership in the Society. In 1943 the Registry came under the joint sponsorship of the American College of Radiology and the American Society of X-Ray Technicians.

The Registry serves the entire United States and exercises reciprocity with Canada and Great Britain. All examinations in the nation for certification are arranged through the Minneapolis headquarters and all applications for examination are processed there.

As of today over 33,000 technicians have been certified by the Registry and the current active roll includes over 27,000 names of x-ray technicians, some of whom are serving in foreign countries. This is the only certifying body for x-ray technicians that is recognized by the American College of Radiology and the American Medical Association.

HISTORICAL COLLECTION ON RADIOGRAPHY

The George Eastman House, Rochester, N. Y., has announced the establishment of a collection on the history of radiography, comprising apparatus, books, periodicals, and radiographs. Through the gift of Mr. Arthur W. Fuchs, a nucleus has already been established, and it is hoped that radiologists and technicians throughout the country will add to this to form as complete a collection as possible.

In making his gift, Mr. Fuchs called attention to the fact that there has not been, in the past, any single repository of historical material of sufficient volume to make it worthwhile to researchers in the field.

It seems particularly fitting that this project should be undertaken by the George Eastman House, a museum of photography housing a unique collection of historical photographs, motion picture films, apparatus, books, manuscripts, and documents on the history of photography. The Library and collections of the museum are available to students, publishers, and other interested persons for inspection. An information service offers research assistance and provides photographs. This service will now be extended to include radiography.

PICKER FOUNDATION AWARDS

On behalf of the James Picker Foundation, the National Academy of Sciences—National Research Council is accepting applications for fellowships and grants in the field of radiology and nuclear medicine for the year 1961–62. Awards are made in four categories: *Advanced Fellowships in Academic Radiology; Postdoctoral Fellowships in Radiological Research; Grants for Scholars; Grants-in-Aid of Research.* Applications should be submitted by Dec. 1, 1960.

Application blanks and further information may be obtained from the Division of Medical Sciences (Room 305, AAUW), National Academy of Sciences—National Research Council, 2101 Constitution Ave., N. W., Washington 25, D. C.

If the proposed studies are to be carried out in Canada, requests for information and application forms should be directed to the Awards Office, National Research Council of Canada, Ottawa 2, Ont., Canada.

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

Our hospital is planning an expanded or new X-ray Department to accommodate the increased volume of work accentuated by the addition of a new wing. In preparation for this project, I have visited many newly constructed departments for ideas and suggestions. I have been especially interested in errors and regretted omissions for, in almost every department visited, something had gone awry. This is not difficult to comprehend when one realizes that almost all radiologists are neophytes in construction and very few architects are well versed in x-ray department construction details.

Some of the omissions or errors I have encountered include the following:

1. Even with the aid of consultants, a new department omitted provisions for a room to segregate incapacitated or ill patients, although this group comprised the major portion of the hospital population.

2. In a new wing no wiring provisions were made for mobile x-ray units.

3. Although a hospital provided accessory diagnostic x-ray and darkrooms on the accident floor, it failed to provide space for a film dryer in that darkroom. Consequently films had to be transported back and forth to the X-ray Department elsewhere and the special accident floor darkroom was seldom used.

4. An enema suite was not equipped with a bedpan sterilizer.

5. In one department the female technicians found it difficult to place cassettes in the pass boxes because they were located at shoulder level (too high up) instead of at waist level.

6. A barium sink was equipped with a conventional trap instead of a barium trap.

7. One cystoscopic room had to be constantly supplied with mops because there were no drains in the floor.

8. Although darkroom floors are subjected to considerable dripping from the transfer of wet films, many hospitals have failed to provide proper drainage.

9. One department failed to provide for conventional developing when its automatic unit required servicing.

I could continue endlessly, but these emphasize the point that minor omissions can cause major headaches.

With the co-operation of radiologists and equipment manufacturers throughout the country, I would like to accumulate and compile basic data for a check-list of technical and other suggestions which can be used by radiologists, hospital officials, and architects so as to avoid similar and other mistakes in future construction.

Contemplated is a check-list in the form of a loose-leaf booklet, which would allow for periodic additions and corrections. These would include check-lists for every room of a new x-ray department.

A notebook will be provided in the Exhibit Hall at the forthcoming Annual Meeting of the Radiological Society of North America at Cincinnati, Ohio, for those who can and wish to enter ideas and suggestions. I will be present at an exhibit in Room 616, Boxes 35–36, for those who personally desire to discuss this project.

It is hoped that there will be sufficient interest generated so that all radiologists who attend the meeting and have recently been involved in construction and can assist with experiences and suggestions, will co-operate, giving their names and addresses, and make notations. Further correspondence will ensue.

It is also hoped that those radiologists who cannot attend the meeting and are interested will encourage the initiation of the project by communicating with me.

Very truly yours,
W. S. ALTMAN, M.D.
32 Spear Street
Quincy 69, Mass.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

MODERN TRENDS IN DIAGNOSTIC RADIOLOGY (THIRD SERIES). Edited by J. W. MCLAREN, M.A., M.R.C.P., F.F.R., D.M.R.E., Radiologist, X-Ray Department, St. Thomas' Hospital, London; Examiner in Radiology to the Examining Board of England and to Edinburgh University; Sometime Examiner in Radiology, University of London and Faculty of Radiologists. A volume of 286 pages, with 209 figures. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N. Y., 1960. Price $16.00.

CARCINOMA IN SITU OF THE UTERINE CERVIX: A STUDY OF 235 CASES FROM THE FREE HOSPITAL FOR WOMEN. By GILFERT H. FRIEDELL, M.D., Associate Pathologist, Massachusetts Memorial Hospitals; Assistant in Pathology, Harvard Medical School; Associate in Pathology, Boston University School of Medicine, Boston, Mass.; ARTHUR T. HERTIG, M.D., Shattuck Professor of Pathologic Anatomy and Head of the Department of Pathology, Harvard Medical School; Consultant in Pathology, Free Hospital for Women and Boston Lying-in Hospital, Boston, Mass.; and PAUL A. YOUNGE, M.D., Assistant Clinical Professor of Gynecology, Harvard Medical School; Associate Chief Surgeon, Free Hospital for Women, Boston, Mass. A volume of 154 pages, with 106 figures and 19 tables. Published by Charles C Thomas, Springfield, Ill., 1960. Price $7.50.

THE BASIC PHYSICS OF RADIATION THERAPY. By JOSEPH SELMAN, M.D., Clinical Assistant Professor of Radiology, The Southwestern Medical School, University of Texas; Director, School for X-ray Technicians, Tyler Junior College; Chief of Radiology Service, Medical Center Hospital; Attending Radiologist, Mother Frances Hospital; Consultant in Radiology, East Texas Tuberculosis Hospital, Tyler, Texas. A volume of 672 pages, with figures and tables. Published by Charles C Thomas, Springfield, Ill., 1960. Price $14.50.

RADIATION INJURY IN MAN: ITS CHEMICAL AND BIOLOGICAL BASIS, PATHOGENESIS AND THERAPY. By EUGENE P. CRONKITE, M.D., Head, Division of Experimental Pathology, Medical Research Center, Brookhaven National Laboratory, Upton, N. Y.; formerly Head, Hematology, Naval Medical Research Institute, Bethesda, Md.; Director of Biomedical Research Atomic Bomb Tests 1953 and Care of Accidental Human Radiation Casualties from Fallout 1954; Member, Committee on Pathologic Effects of Atomic

Radiation and Advisory Committee for Civil Defense of the National Academy of Sciences, and VICTOR P. BOND, M.D., Ph.D., Head, Division of Microbiology, Medical Research Center, Brookhaven National Laboratory, Upton, N. Y.; Formerly Head of Experimental Pathology Branch, United States Naval Radiological Defense Laboratory, San Francisco; Member, of National Advisory Committee on Radiation and Subcommittees of the National Committee on Radiation Protection, and the International Commission on Radiological Units. A volume of 200 pages, with 18 figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $6.50.

CONFERENCE ON EXPERIMENTAL CLINICAL CANCER CHEMOTHERAPY, WASHINGTON, D. C., NOVEMBER 11 AND 12, 1959. Edited by B. H. MORRISON III. National Cancer Institute Monograph No. 3. A paper-bound volume of 308 pages, with figures and tables. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1960. Price $2.00.

Book Reviews

BREAST CANCER: FACTORS MODIFYING PROGNOSIS. By A. J. DELARIO, M.D., Member of the International College of Radiology, the American College of Radiology, the American Board of Radiology, the Radiological Society of North America, the Radiological Society of New Jersey, and the Scientific Advisory Council of the New York Cancer Research Institute, New York, N. Y.; Consultant Radiologist, St. Joseph Hospital, Paterson, N. J. A volume of 208 pages, with 137 tables. Published by The Macmillan Company, New York 11, N. Y., 1959. Price $7.50.

This monograph gives the details of treatment and results in a series of 465 patients with carcinoma of the breast admitted to St. Joseph Hospital, Paterson, N. J., between 1934 and 1951 and followed personally by the author. A 100 per cent follow-up was achieved.

The information is presented in 137 tables supplemented by brief descriptive material. The result is a vast accumulation of statistics relative to prognosis in cases treated by various procedures and combination of procedures, as well as in untreated cases. It is impossible to review all of the author's statistics, but the following statement may be quoted: "The four-year survival rate with nonsurgical methods is almost twice the rate of cases not treated at all. The surgical form of treatment makes it possible for five times as many patients to live four years or more, and four times as many patients to live five years or more as would live if no treatment at all were given."

This book will be of great interest to anyone concerned with the care of patients with cancer of the breast.

RADIOLOGIC RECORDS. By SISTER CHRISTINA SPIRKO, C.S.J., R.T., B.S., in R.T., M.A., F.A.S.X.T., Associated with the Department of Roentgenology, St. Mary's Hospital, Amsterdam, N. Y.; Instructor in Sociology, St. Mary's School of Nursing, Amsterdam, N. Y.; Editor, X-Ray Column, Hospital Management, Chicago, Ill.; Fellow, American Society of X-Ray Technicians. With a Foreword by Joseph Selman, M.D., Tyler Junior College, Tyler, Texas, and an Introduction by Melvin Aspray, M.D., Past President of American Registry of X-Ray Technicians. A volume of 304 pages, with 108 figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $8.50.

In this volume the author has tried to catalogue the many forms and records needed for the efficient conduct of a hospital x-ray department, providing the radiologist with a rich storehouse of knowledge not previously available in one text.

The chapter headings indicate the subjects covered: The Radiologic Record; Identification Methods and Files; Consultation Requests and Work Slips; Roentgenogram Files; Report Files; Radiation Therapy Records; Business Forms; Indexing; Medical Photography; Legal Aspects of Radiologic Records; Microfilming of Radiologic Records; Organization and Administration. There are added two Appendixes: I, compiled by Dr. S. W. Donaldson, "Code Book: Diagnostic and Pathologic Cross Index for Departments of Radiology"; II, "Index for Radiologic Diagnosis."

The author is well qualified by long experience in teaching and administrative work to collect and assemble this material. All who are concerned with the administrative duties of conducting a department of radiology are indebted to her.

ENCYCLOPEDIA OF MEDICAL SYNDROMES. By ROBERT H. DURHAM, M.D., F.A.C.P., Physician-in-Charge, Division of General Medicine, Henry Ford Hospital, Detroit. Foreword by T. R. Harrison, M.D., Professor and Chairman, Department of Medicine, Medical College of Alabama, Birmingham. A volume of 628 pages. Published by Paul B. Hoeber, Inc., Medical Division of Harper & Brothers, New York, 1960. Price $13.50.

The author of this book has attempted to collect and correlate in a single volume the pertinent facts on the known medical syndromes, though admitting that the list can never be complete "as long as there is an ever increasing admixture of human genes . . . and progress in medicine continues to extend longevity." He has succeeded in presenting a concise summary of facts concerning

nearly 1,000 different symptom complexes, including a surprising number of rare and unusual conditions collected from the world literature. The items are presented in alphabetical order, as would be expected in an Encyclopedia. The typographic plan is excellent, with each heading standing out in bold face type followed by the synonyms in italics. Both eponymic and descriptive titles are given and cross-references to related syndromes are included. For example:

Engelmann's syndrome. Synonyms: *Camurati-Engelmann disease; Engelmann's disease; osteopathia hyperostotica multiplex infantilia; polyostotic infantilia; progressive diaphyseal dysplasia. See also Ribbing's syndrome; Morgagni's syndrome; Blount-Barber syndrome; Landouzy-Dejerine syndrome; Roussy-Lévy syndrome; Troell-Junet syndrome; Albright's syndrome; Caffey's syndrome; Gansslen's syndrome.*

The text on each syndrome, although concise, is remarkably comprehensive, with essential facts concerning incidence, sex ratios, congenital and genetic factors, clinical manifestations, and pertinent laboratory and pathologic findings. Biographical references are included. An "index by classification," according to organ systems, provides a convenient mechanism for locating little known or enigmatic syndromes.

As a reference work this volume will be of service to students, teachers, internists, and specialists in many fields of medicine. Roentgenologists will be particularly interested in the many unusual syndromes pertaining to the skeletal system, especially those of genetic origin.

DIE WIRBELSÄULENLEIDEN UND IHRE DIFFERENTIALDIAGNOSE. By PROF. DR. J. E. W. BROCHER, Genf. Fortschr. a. d. Geb. d. Röntgenstrahlen, Ergänzungsband 68. A volume of 458 pages, with 639 illustrations on 287 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 2d ed., 1959. Distributed in United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 128.—($30.50); to subscribers to Fortschritte, DM 115.20—($27.45).

This monograph is the second edition of a comprehensive roentgenographic and clinical study of diseases of the spine. A large section on tuberculosis of the spine is followed by chapters on degenerative diseases, diseases of unknown etiology, other types of spondylitis, tumors, and metabolic diseases which may involve the vertebrae.

There are 287 figures including a total of 639 roentgenographic reproductions, all of quite good quality. These add enormously to the value of the volume. An extensive bibliography is supplied. This book makes a valuable addition to the library of any who are interested in the spine and are able to read German. It is an example of a work which should be translated into English and possibly other languages for wider distribution.

FORTY-SIXTH ANNUAL MEETING: COMMERCIAL EXHIBITS

The following list of exhibits to be presented at the 1960 Meeting of the Radiological Society of North America has been assembled by the Committee on Commercial Exhibits (Dr. Claude R. Snead, Chairman) as a guide for those planning to attend. Manufacturers of radiologic equipment, processing apparatus and chemicals, opaque media, and protective devices, publishers of new and revised texts, and special service organizations have all made significant contributions to our specialty. Time spent in the Commercial Exhibits Section will be time put to good use.

Abbott Laboratories, North Chicago, Ill. (Booth 77).

Albert Acan X-ray Solutions, Inc., Detroit, Mich. (Booth 78): The representatives in Booth 78, X-Ray Solution Services, will demonstrate the value of their service in the hospital and private office, showing how time, labor, and money may be saved and diagnostic standards maintained with any choice of Ansco, du Pont, or Kodak chemicals.

American Society of X-Ray Technicians (Booth 143).

Ansco Division of General Aniline and Film Corporation, Binghamton, N. Y. (Booths 43–44): The Ansco exhibit will feature its Bulkpak, a convenient, economical package designed for volume users of Ansco's medical x-ray films. In addition, a new contribution for radiologists will be added to the list of Ansco "Aids" presently available: *A Primer of Radiation Protection*, by R. J. Schulz, Assistant Professor of Radiology, Albert Einstein College of Medicine.

Atomic Energy of Canada Ltd., Ottawa, Ont. (Booths 28–29): Atomic Energy of Canada will display the new Theratron "F" high-output, long-treatment-distance cobalt teletherapy unit, for full fixed or moving-beam treatment flexibility.

Complete information will also be available about A.E.C.L.'s high activity cobalt, gold seeds, radium, tantalum, and other radioisotopes of interest in radiotherapy.

Automatic Seriograph Corporation, College Park, Md. (Booth 79).

Baird-Atomic, Inc., Cambridge, Mass. (Booth 123): Baird-Atomic, manufacturer of scientific instruments for analysis and control, will show an advanced medical uptake system and a large-well gamma scintillation detector. Baird-Atomic scalers will also be on display.

Barnes-Hind Barium Products Company, Sunnyvale, Calif. (Booth 80): Barnes-Hind Barium Products Company will exhibit their specially processed micronized barium sulfate, under the trademark "Barotrast."

The Pneumocolon will be demonstrated and its effectiveness in the administration of Barotrast or air in colonic radiographic examination will be stressed.

Advance information will be distributed on a new product called "Clysodrast," a new type of purgative used in the preparation of the large bowel for radiographic study.

Bar-Ray Products, Inc., Brooklyn, N. Y. (Booths 33–34). Bar-Ray Products will display a B859 30-30 Royal Film processing tank with an Indian coral colored exterior. It is only 34 inches high and has wide splayed edges to catch chemical splash.

Also exhibited will be an assortment of radiation protective garments made of a new lead vinyl material Leadx.

Bell-Craig, Inc., New York, N. Y. (Booth 86): The Bell-Craig display will consist of a complete line of radiopaque media and U.S.P. bariums (Baroloid, Ultrapaque, and Raybar F.B.S.), cholagogues for ductal demonstration in cholecystography (Neo-Cholex and Cholex), aqueous contrast solution for cholangiography and hysterosalpingography (Medopaque), and an improved, disposable rectal catheter (Cly-Tips).

Buck X-Ograph Company, St. Louis, Mo. (Booths 104–105).

Carr Corporation, Santa Monica, Calif. (Booths 20–21).

Coca-Cola Company, Atlanta, Ga. (Booth 7): Ice-cold Coca-Cola will be served through the courtesy and cooperation of the Coca-Cola Bottling Works Company, of Cincinnati, Ohio, and the Coca-Cola Company.

Lester A. Dine Company, Woodside, N. Y. (Booth 23): The sensational new Eastman Kodak Startech camera will be featured by the Lester A. Dine Co. This camera has been designed with an F64 diaphragm which means that each picture has

extreme depth plus ideal color rendition. In addition, the instrument is priced far lower than any other clinical camera. As an accessory for the Startech there is an attachment for copying large roentgenograms into small transparencies.

Dunlee Corporation, Bellwood, Ill. (Booths 129–130): The Dunlee Corporation will display a complete line of x-ray tube units, replacement inserts, and valve tubes. There will be featured this year the new Dunlee double-speed rotating anode units.

E. I. du Pont de Nemours & Company, Wilmington, Del. (Booths 35–38): E. I. du Pont de Nemours & Company's exhibit will feature du Pont medical x-ray products, specifically du Pont 508 Medical X-ray Thrift Pak Film and Patterson* Intensifying Screens. Technical literature will be available to radiologists at no charge.

Eastman Kodak Company, Rochester, N. Y. (Booths 24–27): The Kodak X-Omat Processor will be demonstrated in the Eastman Kodak Company exhibit. There will also be displayed the various Kodak medical x-ray materials and chemicals, the two new types of Kodak Ready Pack films, and the Kodak Kidney film. Technical aids and charts will be shown, as will the Kodak Startech camera.

Eureka X-ray Tube Corporation, Chicago, Ill. (Booths 114–115).

Oscar Fisher Company, Inc., Newburgh, N. Y. (Booths 112–113): The Oscar Fisher Company will exhibit automatic rapid processing equipment for the processing of x-ray cut film as well as cineradiographic films and electroencephalographic, angiocardiographic, and electrocardiographic papers. The equipment to be displayed is fabricated entirely of Type 316 stainless steel and is now in use in hospitals and industrial radiographic departments throughout the country.

C. B. Fleet Company, Inc., Lynchburg, Va. (Booth 88): The C. B. Fleet Company will feature *A Simplified, Safe and Satisfactory Method of Preparation for Barium Enema Studies*, a clinical report of a recently concluded study of a series of 250 cases. An abstract of the report and personalized instructions for patient distribution may be obtained at Booth 88.

Forsyth X-ray Corporation, Chicago, Ill. (Booths 81–82).

E. Fougera and Company, Hicksville, N. Y. (Booth 110): The exhibit of E. Fougera & Company will call attention to its line of x-ray contrast media. Featured will be Orabilex, the advanced oral cholecystographic agent, now enjoying widespread clinical use. Literature and trial material may be requested from the representatives in attendance. Information on contrast agents for bronchography, hysterosalpingography, and other procedures will be available.

Franklin X-ray Corporation, Philadelphia, Penna. (Booths 17–18).

Frigidheat Industries, Nashville, Tenn. (Booth 90): Frigidheat Industries will show a new device for cooling or heating liquids on the end of a stick, so to speak. The models displayed are primarily for cooling or heating x-ray processing solutions, but have many other applications as well.

General Electric Company, X-Ray Department, Milwaukee, Wisc. (Booths 45–52).

Gordon Consultants, Kent Cliffs, N. Y. (Booth 135): Gordon Consultants will demonstrate the new line of Gordon full-size x-ray film custom-built projectors, each one designed for specific hospital requirements. Among these will be the Walter Reed model with attachments for 2 × 2- and 3 × 4-inch slides, opaque projection of specimens, and a means for scanning a full-size film with a magnification of ×25. The Gordon pocket stereoscope, standard equipment for all U. S. military hospital installations, will also be shown.

Grune & Stratton, Inc., New York, N. Y. (Booth 89): Grune & Stratton will feature *Diagnostic Roentgenology of the Digestive Tract Without Contrast Media*, by Wolf, Khilnani, and Lautkin and Zimmer's *Artifacts and Handling and Processing Faults on X-Ray Films*, as well as the monumental three-volume set of Schaltenbrand and Bailey's *Introduction to Stereotaxis, with An Atlas of the Human Brain*.

Halsey X-ray Products, Inc., Brooklyn, N. Y. (Booths 14–16): Halsey X-Ray Products will exhibit Sigma-Lux, the result of recent significant technological advances. This product is of general interest to all radiologists and represents a real technical break-through for greater efficiency and economy.

A device for arteriovascular serial films up to 14 × 36 inches in size will also be demonstrated.

High Voltage Engineering Corporation, Burlington, Mass. (Booths 106–107): High Voltage Engineering Corporation, the world's leading manufacturer of accelerators, will present new developments in microwave linear accelerators expressly designed for supervoltage therapy. Also of interest will be the considerable technical information available on work being done with the standard supervoltage Van de Graaff units and linear accelerators.

Paul B. Hoeber, Inc., New York, N. Y. (Booth 6): Among the important new books to be

* Du Pont trademark.

on display at the Hoeber booth will be Paul and Juhl's *Essentials of Roentgen Interpretation;* Coley's *Neoplasms of Bone*, 2nd edition; Shapiro and Janzen's *The Normal Skull;* Dargeon's *Tumors of Childhood;* Dalsace and Garcia-Calderon's *Radiologic Gynecology;* the fourth volume in the famous Pack and Ariel series, *Tumors of the Breast, Chest, and Esophagus.* A representative will be on hand to welcome visitors and give help in any way possible.

Hoffmann-La Roche, Inc., Nutley, N. J. (Booth 128): Roche Laboratories will feature Tigan, a specific anti-emetic agent effective both prophylactically and therapeutically against most clinically significant types of nausea and vomiting.

Hospital Microfilming, Pearl River, N. Y. (Booth 87): The Atlantic x-ray microfilm camera will be on display with the Atlantic x-ray microfilm projector at the Hospital Microfilming booth. Representatives will be available for discussion of film and processing technics, all procedures and details followed in contract service programs for hospital files, slide service for teaching films, and the "all-new unit-card" method that eliminates the use of microfilm in roll form.

Howden Vidcor Products Corporation, Mount Vernon, N. Y. (Booth 121).

Philip A. Hunt Company, Palisades Park, N. J. (Booth 132): The Philip A. Hunt Company will display the Type 3 Graph-O-Mat, the new Hunt 2-solution system for processing Ansco, du Pont, Kodak, Ilford, and Gevaert films in automatic roller-type x-ray film processors. There will also be an exhibit of all manufacturers' films processed in the new Type 3 Graph-O-Mat, which completely hardens the x-ray film emulsion during high-temperature development.

Ilford, Inc., New York, N. Y. (Booth 84): The Ilford Exhibit will feature Red Seal and Ilfex films used in routine as well as extraordinary technics. Ilford's double and triple film cassettes will be demonstrated and films illustrating this unique technic will be displayed. A new companion to *Positioning in Radiography* will be introduced and a wide assortment of literature will be available.

A cordial invitation is extended to all in attendance at the Meeting to visit the Ilford booth and discuss any of their products with the representatives in attendance.

Lea & Febiger, Philadelphia, Penna. (Booth 94): At the Lea & Febiger booth everyone should be sure to see Fried's *Tumors of the Lungs and Mediastinum;* Jaffe's *Tumors and Tumorous Conditions of the Bones and Joints;* Zimmerman, Netsky and Davidoff's *Atlas of Tumors of the Nervous System;* Epstein's *Clinical Radiology of Abdominal Disorders;* Quimby, Feitelberg and Silver's *Radioactive Isotopes in Clinical Practice;* Ritvo's *Chest X-Ray Diagnosis* and *Bone and Joint X-Ray Diagnosis;* Ritvo and Shauffer's *Gastrointestinal X-Ray Diagnosis;* Epstein's *The Spine;* Epstein and Davidoff's *Atlas of Skull Roentgenograms;* Davidoff and Epstein's *The Abnormal Pneumoencephalogram;* Holmes and Robbins' *Roentgen Interpretation;* Rhinehart's *Roentgenographic Technique;* Pohle's *Clinical Radiation Therapy.*

Leishman X-ray Engineering Company, Los Angeles, Calif. (Booths 1–2).

Liberty Protective Leathers, Inc., Gloversville, N. Y. (Booth 125): Standard x-ray gloves, aprons, and equipment for patient protection will be exhibited at the Libery Protective Leathers booth. A new x-ray apron extending above the shoulders, with a white washable surface, and a new type of gonad shield will be featured.

Liebel-Flarsheim Company, Cincinnati, Ohio (Booth 103): Representatives of the Liebel-Flarsheim Company will show and answer questions about grids, Buckys, and other L-F x-ray specialties which are available from all x-ray equipment manufacturers. Competent personnel will be on hand to render any possible service. Members and guests of the Radiological Society are invited to visit the modern L-F factory while in Cincinnati.

Little, Brown & Company, Boston, Mass. (Booth 141): Little, Brown & Company's exhibit will center around one of the major publishing achievements in modern radiology, the two-volume work *Angiography,* edited by Herbert L. Abrams, M.D., Department of Radiology, Stanford University School of Medicine. Radiologists from the world's major centers contribute to embrace the whole of angiography in one comprehensive work. Visitors should make sure to see *Angiography* and other Little, Brown books including Martin and Martin: *Low Intensity Radium Therapy;* Walter and Miller: *A Short Textbook of Radiotherapy;* Field: *Cancer: Diagnosis and Treatment;* Ariel and Pack: *Cancer and Allied Diseases of Infancy and Childhood;* Benedict and Nardi: *The Esophagus;* King and Fletcher: *Industrial Pulmonary Diseases.*

LogEtronics, Inc., Alexandria, Va. (Booth 101). An electronic x-ray copying instrument which produces photographic copies with improved visibility of x-ray detail will be shown in the LogEtronics booth. There will also be displayed the LogEtronic Printer and illustrative LogEgram results.

Low X-Ray Corporation, New York, N. Y. (Booths 108–109): The Low X-Ray Corporation, exclusive distributors for Gevaert x-ray films, will

exhibit high-speed and ultraspeed, interleaved and non-interleaved films; single packages and "Econopak" bulk cartons; envelope-packed screen and non-screen film; photoroentgen and cineradiographic film.

Donald McElroy, Chicago, Ill. (Booth 99).

Machlett Laboratories, Inc., Springdale, Conn. (Booths 19–22): The Machlett Laboratories exhibit will be highlighted by two new tubes of unusual interest for radiology, the new Dynamax "50" series and the ML-9421 x-ray image intensifier tube. The Dynamax "50" series provides rotating anode x-ray tubes incorporating the new high-speed rotor and the grid-controlled cathode. Useful for technics up to 150 pkv, the DX-50 tubes permit maximum short exposure ratings approximately 70 per cent higher than conventional tubes. The ML-9421 is an x-ray brightness amplifier permitting a brightness increase of 3,000 ×, as compared to the conventional fluoroscopic screen. This bright image can be viewed directly, photographed, or monitored by a television system.

Mallinckrodt Chemical Works, St. Louis, Mo. (Booth 131): A cordial invitation is extended to members and guests of the Radiological Society of North America to visit the Mallinckrodt booth, No. 131.

Featured will be Ditriokon,* a new contrast agent for angiocardiography, which was developed to satisfy the need for a less viscous medium. Also shown will be Miokon,* Thixokon,* Pyelokon-R,* and Urokon* 30, 50, and 70%, as well as barium sulfate. Representatives in attendance will be glad to discuss the chemicals on display.

Marion Laboratories, Inc., Kansas City, Mo. (Booth 117): For the first time anywhere, Marion Laboratories will exhibit a revolutionary new radiation dosimeter, Radipol, which works on a radiation polymerization principle. This simple, inexpensive device will be a great help toward more accurate measurement of delivered doses, in both calibration of equipment and therapy.

Mattern X-Ray Division of Land-Air, Inc., Chicago, Ill. (Booths 8–9): The Mattern X-Ray Division of Land-Air will display the Mattern Sovereign 90-90 x-ray table with full 180° angulation from 90° Trendelenburg to 90° vertical, motor-driven angulation, and optional power assist for the spot device tower. Rugged construction permits performance under the heaviest x-ray schedule.

The Mattern Sovereign 500 Hi-Kv X-Ray Control with 1/120 second electronic timer will also be exhibited. This Control will power various combinations of 2 or 3 x-ray tubes, and up to 5 Buckys.

Micro X-Ray Recorder, Inc., Chicago, Ill. (Booth 100): The Micro X-Ray Recorder exhibit will feature the Micro X-Ray Recorder, a microfilming unit that will record roentgenograms, photographs, charts, electrocardiograms, case histories, and specimens on a 100-foot roll of 35-mm film. Of special interest is its two-lens system and provision for lightening up overexposed films.

The Micro X-Ray Recorder, PV-501 Projector-Viewer, Indexer, and 35-mm. mounts and other accessories will also be shown, as will a new series of 35-mm. Micro X-Ray Recorder slides for lectures, teaching, and reference.

Mid-West Glove Company, Inc., Chicago, Ill. (Booth 134): Something new for the 1960 Security line of x-ray protective gloves and aprons will be exhibited at the Mid-West Glove Company booth for the first time: a lightweight, flexible, vinyl lead, 2-ply apron that is strong, washable, and safe. New design aprons for patient protection as well as famous Security gloves will also be shown.

Montpyne X-Ray Corporation, New York, N. Y. (Booth 119): Ferrania medical x-ray film will be displayed for the first time in America at the Montpyne X-Ray Corporation booth. Ferrania is one of Europe's oldest and most respected manufacturers of photosensitized products and its name has been a byword for progressive and advanced technology. Its medical x-ray film ranks second to none for overall dependability.

North American Philips Company, Inc., New York, N. Y. (Booths 11–13): The Philips - Norelco exhibit will include the compatible radiological and intensification unit with cineradiography and TV televiewing. Factory personnel with ten years of experience gained through the installation of well over 2,500 integrated systems, will be at Booths 11–13 to help with any special problem.

Nuclear-Chicago Corporation, Des Plaines, Ill. (Booth 97).

Nuclear Consultants Corporation, St. Louis, Mo. (Booth 118).

Nuclear Measurements Corporation, Indianapolis, Ind. (Booth 111).

Old Delft Optical Company, Inc., Hicksville, N. Y. (Booth 124): At the Old Delft Optical Company booth there will be on display a new type Odelca with a rapid-roller film changer which permits high-sequence photofluorography up to 6 exposures per second. This camera has an automatic film-feed system for 4 × 4-inch cut films. It was first presented at the Ninth

* Reg. U. S. Pat. Off.

International Congress of Radiology, Munich, where it attracted keen interest.

Pako Corporation, Minneapolis, Minn. (Booths 30–32): A new system for automatic, hangerless processing will be exhibited for the first time in the Pako booth. The new Pakarol-X Prosser, 32 × 90 inches in size, delivers dry film in six and one-half minutes. Also displayed will be stainless steel Filmtanx for manual processing, as well as 2 cassette holders and associate processing accessories.

Physicians Technical Equipment Company, Milwaukee, Wisc. (Booth 137).

Physics Committee of the Radiological Society of North America (Booth 116): In Booth 116 there will be a demonstration of the new Therapy Charts (see RADIOLOGY **74:** 843–858, May 1960) prepared by Milford D. Schulz, M.D., Chairman, and John Hale, Ph.D., for the Physics Committee of the Radiological Society of North America.

Picker X-Ray Corporation, White Plains, N. Y. (Booths 65–68; 138–139): The Nuclear Division of Picker X-Ray Corporation will display two scanners—one with photorecording and full contrast control and the other intended for use in conjunction with smaller programs. In addition, there will be shown a dual unit for kidney function studies, a simplified pulse height analyzer, and a full selection of scalers, ratemeters, scintillation detectors, and accessories.

Profexray, Inc., Maywood, Ill. (Booths 61–64).

Radiology, Detroit, Mich. (Booth 142). In the interests of better illustrative material, RADIOLOGY (the official organ of the R.S.N.A.) will present an exhibit showing the various steps in the reproduction of a roentgenogram up to its final appearance in the pages of the journal. Reprints of a paper on *The Editor's Responsibility*, containing many helpful suggestions for the preparation of papers, will be available.

Radium Chemical Company, Inc., New York, N. Y. (Booth 136): The Radium Chemical Company will display modern cervical-uterine radium applicators. The latest instruments and accessories for the handling and application of radium and radon will be demonstrated by company representatives. New protective equipment designed for transport, storage, and handling of radium in hospitals and offices will be featured.

Rapi-Dex, Falls Church, Va. (Booth 85): At Booth 85 will be shown the Rapi-Dex, a completely automatic medical and industrial x-ray film processor of simple design and easy maintenance, capable of processing 4 × 5-inch to 14 × 17-inch film. Dry film is delivered quickly with machine or standard chemicals. Rapi-Dex can be used for manual as well as automatic processing.

S. & S. X-Ray Products, Inc., Brooklyn, N. Y. (Booth 91): The S. & S. X-Ray Products display will feature the new lead-lined steel Protecto panels, assembled into a control booth. Other S. & S. accessory items to be shown will include x-ray illuminators, stainless tanks, darkroom equipment and a complete line of x-ray files. A new enlarged accessory catalog will be distributed.

W. B. Saunders Company, Philadelphia, Penna. (Booth 120): W. B. Saunders Company will feature the completed set of Shanks and Kerley: *X-Ray Diagnosis*, 3d edition; Meschan: *Roentgen Signs in Clinical Diagnosis;* Murphy: *Radiation Therapy;* Meschan: *Radiographic Anatomy.*

Schick X-Ray Company, Inc., Chicago, Ill. (Booth 10): Schick X-Ray Company is the exclusive United States distributor of Elema-Schönander AB of Stockholm, Sweden. Equipment sold covers a full line of units for all types of angiography, such as rapid changers for roll or cut film, high pressure syringes, and special tables. In addition, there will be exhibited the famous Lysholm skull unit, the Triplex Angiomatic three-phase generating unit, as well as the new line of Lysholm grids.

Frank Scholz Corporation, Boston, Mass. (Booths 92–93).

Siemens New York, Inc., X-Ray Division, New York, N. Y. (Booths 95–96): Siemens will exhibit a 3-phase diagnostic generator—Tridoros 5 with dry rectifiers, 700 ma output. It offers a free choice of kv and mas or kv, ma, time (1/120 second), thus permitting full exploitation of both tube foci and generator; also a tilt-table with a motor-driven top.

E. R. Squibb & Sons, New York, N. Y. (Booth 102): E. R. Squibb & Sons has long been a leader in the development of new agents for the prevention and treatment of disease. The results of its diligent research are available to the medical profession in the new products or improvements in those already marketed.

Standard X-Ray Company, Chicago, Ill. (Booths 39–42): The Standard X-Ray Company will demonstrate their new Standex manual ceiling mounted tube hanger designed to meet the requirements of ease and accuracy of positioning, the Standard Model GR-200 ma mobile unit for operation on both 110-volt and 220-volt electrical service, and Model H-90 super tilt radiographic and fluoroscopic table.

Tracerlab Inc., Waltham, Mass. (Booths 53–60): On display in the combined Tracerlab-Keleket booth will be the newest concepts in nuclear instrumentation for the radioisotope laboratory or clinic, including up-to-date scanning, uptake, and localization equipment.

There will also be on exhibit Keleket's new 9-inch image intensification systems with 3,000X intensification. Arrangements have been made for live demonstrations in Keleket's new mobile display situated in a location convenient to the exhibit hall.

United States Radium Corporation, Morristown, N. J. (Booth 133): The United States Radium Corporation (Rādelin) will feature Rād-a-lert, a new plastic fluoroscopic screen with a special border which fluoresces red to alert the doctor to unabsorbed radiation reaching the outer limits of the screen. Rādelin aluminized TF screens, which provide 50 per cent exposure reduction compared to medium speed screens, with comparable detail, will also be shown.

Victoreen Instrument Company, Cleveland, Ohio (Booth 140): In its exhibit the Victoreen Instrument Company will introduce a new low-energy survey meter with an extreme sensitivity over a broad energy range, from 6.5 kev to 1.2 Mev. The instrument features a vibrating capacitor design and has 5 full-scale ranges from 0-3 to 0-300 mr/hr. Other x-ray measurement and calibration equipment will also be displayed.

Volk Radio-Chemical Company, Chicago, Ill. (Booth 122): Volk's full line of precalibrated radiopharmaceuticals for diagnosis and therapy in nuclear medicine will be featured in Booth 122.

Full information will be available on the new exclusive Volk products, Phosphocol (a superior colloidal chromic phosphate-P-32) for palliation of malignant effusions and Polymetaphosphate-P-32 for palliation of metastatic lesions to bone.

Westinghouse Electric Corporation, Baltimore, Md. (Booths 69–76): Westinghouse will feature a complete diagnostic "package" consisting of Sierra, a flexible, omnidirectional, overhead tube stand with the stability and rigidity of floor-to-ceiling mounts; Capri, a fully enclosed radiographic-fluoroscopic table with counterbalanced radiation shield; Nassau, a side-loading spot-film device with single-lever shutter control; Riviera, a 500 ma/150 kv generator.

Williams & Wilkins Company, Baltimore, Md. (Booth 127): Among the new and standard publications which will be on view at the Williams and Wilkins Company booth will be: Brailsford: *Radiology of Bones and Joints;* Brombart: *Clinical Radiology of the Esophagus;* Golden: *Diagnostic Roentgenology;* Hamilton and Simon: *Surface and Radiological Anatomy;* Shy, Bradley and Matthews: *External Collimation Detection of Intracranial Neoplasia with Unstable Nuclides.*

It will also be possible to look over the outstanding British journal, *Clinical Radiology: Journal of the Faculty of Radiologists,* which is now appearing in a new format.

Winthrop Laboratories, New York, N. Y. (Booth 126): Members of the Radiological Society and friends are cordially invited to visit the Winthrop Laboratories booth where representatives will gladly show and discuss all Winthrop products. Featured are Retropaque®, the new Skiodan® neomycin combination for retrograde pyelography, Telepaque® for standard as well as special oral cholangiography, *e.g.*, the four-day Telepaque Test, Hypaque® for excretion urography and all forms of angiography and Hypaque Oral liquid and powder for greater versatility in gastroenterography.

Wolf X-Ray Products, Inc., Brooklyn, N. Y. (Booths 3–5): Wolf X-Ray Products, Inc. will devote its space to a comprehensive line of protective and processing accessories. Among the high lights will be the "Feather-Lite," all plastic, noncorrosive illuminator, new and economically designed protective floor screens, and durable stainless steel developing tanks.

Year Book Publishers, Inc., Chicago, Ill. (Booth 83): The Year Book Publishers will display their complete line of radiology books, featuring the new revised editions of Caffey's *Pediatric X-Ray Diagnosis,* Fields and Seed's *Clinical Use of Radioisotopes,* and Volume 3 of Glasser's *Medical Physics.*

Other well known texts and monographs will be shown, as Kjellberg's *Diagnosis of Congenital Heart Disease,* Singleton's *X-Ray Diagnosis of the Alimentary Tract in Infants and Children,* Lusted and Keats' *Atlas of Roentgenographic Measurement,* Morgan's *Handbook of Radiology,* Randall's *Elements of Biophysics,* Cave's *Fractures and Other Injuries.*

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Pontine Angle Tumour: Encephalographic Appearances. Bengt Liliequist. Acta radiol. Suppl. 186, 1959. (Serafimerlasarettet, Stockholm, Sweden)

Sixty-four cases of extracerebral space-occupying lesions in the pontine angle studied by lumbar encephalography at the Serafimerlasarettet, Sweden, are the subject of this monograph. By far the most frequent lesion was neurinoma arising from the acoustic nerve, of which there were 50 cases. This tumor accounted for between 8 and 12 per cent of all intracranial expansive processes.

The anatomic boundaries of the pontine angle are formed by the pons and the uppermost portion of the medulla oblongata, by the temporal bone and the tentorium attached along its superior margin, and by the anterior-inferior surface of the cerebellum. Between these structures lies a fairly extensive subarachnoid space, the pontocerebellar cistern. This is seen at encephalography as a layer of air extending along the temporal bone. Medially it becomes continuous with the medullary cistern posteriorly and with the pontine and ambient cisterns anteriorly. The two pontocerebellar cisterns are usually symmetrical and extend laterally beyond the porus acusticus internus. In 15 per cent of cases the cistern is very wide, while in 7 per cent it is quite short, terminating immediately lateral to the porus.

As tumors in the pontine angle, when they have reached a certain size, give rise to a characteristic clinico-neurologic syndrome, as well as roentgenographically demonstrable changes in the petrous bone in most cases, many investigators consider further diagnostic aids superfluous. Hence acoustic nerve tumors producing neither typical clinical nor bony change often fail to be diagnosed until late in their course. At the Serafimerlasarettet, processes in the posterior fossa, including those with increased intracranial pressure, have long been the subject of routine study by lumbar encephalography. The Lindgren method is used, with air injected before withdrawal of cerebrospinal fluid, thus reducing the risk of tonsillar herniation.

Encephalographic changes resulting from neurinoma are discussed, the findings being divided into three groups: (1) changes in the cisterns of the posterior fossa; (2) changes in the cisterns in the tentorial notch and in the suprasellar cisterns, and (3) changes in the ventricular system. Changes in the pontocerebellar cistern constitute the most important and characteristic features. A small tumor outside the porus may bulge into this cistern and be enveloped by it. With larger tumors it may be raised from the petrous temporal bone with a layer of air which wholly or partially surrounds the tumor. Often there is nonfilling of the cistern, due to obliteration by tumor.

Other important and reliable findings from a diagnostic point of view are: widening and dilatation of the ipsilateral medullary cistern, which is often delimited laterally by a tumor pole; widening of the ipsilateral ambient cistern; deformation of the lateral surface of the pons; deformation and displacement, mainly in a lateral direction, of the fourth ventricle.

When an acoustic tumor is clinically suspected, lumbar encephalography is believed indicated not only to demonstrate that an expansive process exists but also to determine, if possible, its extent and topography. To better assess these latter features, the roentgen changes were compared with the surgical reports with respect to the size, shape, and position of the tumors.

The 50 acoustic lesions were divided into three groups: Group 1. Small neurinomas not exceeding a hazelnut in size and not encroaching upon any adjacent nerves. Group 2. Medium-sized tumors, some slightly larger than a walnut, extending to the 9th and 10th cranial nerves without displacing them. Group 3. Large tumors extending to the foramen magnum or displacing the 9th and 10th nerves.

There were only 4 neurinomas of small size, these forming a homogeneous group, roentgenologically speaking, in which the tumor was surrounded by air in a slightly widened pontocerebellar cistern. Although the tumors were small, in 3 cases the pons was deformed close to the mass, its lateral surface being slightly flattened. The cerebellum may be elevated as by larger tumors but to a lesser degree. Group 2 comprised 16 cases and Group 3, 30 cases. Encephalographic abnormalities showed great variation in these two groups but were essentially of the same type.

Although the appearance of the cisterns to some extent gave information regarding tumor size, greater certainty as to actual dimensions could be reached if the fourth ventricle was examined. This structure was filled in 36 of the 50 cases. Only with the very small tumor is the fourth ventricle normal in appearance. Group 2 tumors usually produced only slight or moderate alteration unless the tumor was deeply embedded in the cerebellum. With large tumors the fourth ventricle always showed marked abnormality, changes being mainly in the form of displacement laterally and slightly posteriorly, rotation, and flattening obliquely from below and from the side. Changes in the aqueduct usually consisted in an alteration of its shape into a smooth rounded curve, and did not contribute to estimation of size and location of the lesion.

There were 14 expansive processes other than acoustic neurinoma in the series studied. These may be divided into two groups, namely, those situated wholly within the posterior cranial fossa and those lying in both the posterior and middle fossae. The former include meningioma from the posterior surface of the petrous bone, neurinoma from the trigeminal nerve, chondroma, cholesteatoma, ependymoma, choroid plexus papilloma, subarachnoid cysts, and vascular anomalies. The other group consists primarily of neurinoma of the gasserian ganglion, meningioma from Meckel's cavity, and some chondromas from the base of the skull. Chordoma and clivus meningioma may also grow into the pontine angle. The tumors of this second group produce changes both in the pontine angle and the middle fossa and thus are distinguishable from tumors situated wholly within the posterior fossa.

If the lesion is situated wholly within the posterior fossa, encephalography does not give information regarding the type. The one exception is the pontine angle meningioma which may be low and angular in shape, in contrast to the conical shape of the neurinoma. Nonfilling of one of the pontocerebellar cisterns without other changes may be due to a subarachnoid cyst or to adhesions in the cistern.

Fifty roentgenograms; 1 photograph; 61 drawings.

CHARLES M. GREENWALD, M.D.
St. Cloud, Minn.

Calcification of the Basal Ganglia of the Brain. A. J. Palubinskas and Hugh Davies. Am. J. Roentgenol. **82:** 806–822, November 1959. (H. D., The National Hospital, Queen Square, London, England)

Physiologic intracranial calcification visible on roentgen examination of the skull is familiar, being seen most often in the pineal gland and less frequently in the choroid plexuses and falx cerebri. Less commonly, abnormal intracranial calcific deposits are observed on roentgenograms of the cranial vault, due to degenerative changes secondary to trauma, infection, infestation, congenital abnormalities, new growth, metabolic disorders, aging, and unknown factors.

Rarely, the calcifications are bilateral, symmetric, and located in the basal ganglia of the brain, often with concomitant calcific deposits in the dentate nuclei of the cerebellum.

The present report includes several case studies of patients found to have calcification of the basal ganglia and illustrates the many disease processes in which this unusual finding has been observed.

Microscopic calcareous deposits in the basal ganglia are not unusual incidental findings in routine autopsy material. On the other hand, gross calcification at this site, visible on roentgenograms of the skull, is rare. It has been seen most frequently in chronic hypoparathyroidism, either idiopathic or postoperative, and in pseudohypoparathyroidism. In recent reviews about one-seventh of the cases of idiopathic hypoparathyroidism and about a third of the patients with pseudohypoparathyroidism showed bilateral basal ganglia calcification.

The exact etiologic factor or factors responsible for these deposits in the basal ganglia, dentate nuclei, and other areas of the cerebral and cerebellar hemispheres are still obscure. However, after study of the published reports in the literature, it is difficult to avoid the speculation that the underlying causative factor is a transient or permanent dysfunction of parathyroid homeostatis due either to an inherited, developmental, or acquired defect.

When the calcification in the basal ganglia is extensive, little difficulty is encountered in its proper anatomic localization, provided roentgenograms are obtained in the usual complement of views of the skull. Calcification in the dentate nuclei is commonly obscured in the lateral view by the mastoid bones, but is well demonstrated in Towne's projection.

There do not appear to be any distinctive features in the pattern or extent of intracranial calcification which might serve to distinguish the groups of patients with basal ganglia calcification. The pattern and degree vary considerably from small, irregular, discrete shadows of increased density to large coalescing calcific masses. The radiating pattern noted in some patients appears to be due to calcium deposition in the gray matter between the bundles of white fibers of the internal capsule.

There are difficulties in differential diagnosis worth mentioning. Symmetric calcification in the choroid plexuses may cause some confusion. Usually, however, such calcification occurs in the region of the genu of the lateral ventricles, well posterior to the anatomic position of the basal ganglia. Raised intracranial pressure with papilledema occurs in some patients with hypoparathyroidism and basal ganglia calcification, apparently due to cerebral edema. The bilateral symmetric character of the calcification should help to eliminate the possibility of a calcium-containing new growth.

Calcific deposits in the basal ganglia due to tuberous sclerosis and toxoplasmosis have been observed, but not the dense, symmetric, bilateral calcifications seen in the groups of patients discussed here.

An instance of spontaneous conversion of pseudohypoparathyroidism into pseudo-pseudohypoparathyroidism, with the concomitant development of calcification in the basal ganglia, is presented. The suggestion is made that pseudohypothyroidism and so-called pseudo-pseudohypoparathyroidism result from similar or identical genetic abnormalities and that some cases of pseudohypoparathyroidism may, with increasing age, acquire normal plasma levels of calcium and phosphorus, in effect converting from one to the other disease.

Twenty-nine roentgenograms; 1 genealogical chart.

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Anaheim, Calif.

The Cavum Veli Interpositi and Its Differentiation from Cavum Vergae. Hans Zellweger and E. F. Van Epps. Am. J. Roentgenol. **82:** 793–805, November 1959. (University Hospitals, Iowa City, Iowa)

The authors present 9 cases of visualization of the cavum veli interpositi. These, together with 42 previously reported examples, are analyzed, and the clinical findings as well as the pneumoencephalographic picture are described.

The cavum veli interpositi is a true cisternal structure (cisterna interventricularis) representing a persistence of the embryonic choroid fissure, which is normally obliterated. Failure of the fissure to close has been attributed to hypoplasia or disease of the corpus callosum and to tumors in this area producing distortion of the structures.

The cavum veli interpositi is best identified in lateral stereoscopic projections. When filled with air, it is seen to lie above and posterior to the third ventricle. Its size, shape, and degree of filling vary from case to case. When it is large and air-filled, its anterior portion lies behind the foramen of Monro; its posterior superior margin or border is idented by the splenium of the corpus callosum; its anterior border is separated from the third ventricle (if filled with air), and its inferior margin is indented by the great vein of Galen.

In the anterposterior view, the cavum veli interpositi appears as an air-filled structure of varying size and contour situated between Parts 2 and 3 of the lateral ventricles beneath the fornices and above the third ventricle. The fornices, when visualized, hang down or droop from their usual horizontal position. The third ventricle, when it is well filled, may obscure the margins of the cavum.

The cavum veli interpositi has to be distinguished primarily from the cavum septi pellucidi and cavum Vergae. Differentiation of cavum pellucidi is not difficult, since in the lateral projection this lies in front of the foramen of Monro, whereas the cavum veli interpositic lies behind it.

It is more difficult to distinguish the cavum veli interpositi from a cavum Vergae. The cavum Vergae is related anteriorly to the aqueduct of the cavum septi pellucidi; superiorly to the lower surface of the corpus callosum; inferiorly to the upper surface of the hippocampal commissure; laterally to the posterior limbs of the fornices.

Schwidde found a cavum septi pellucidi in 20.43 per cent and a cavum Vergae in 2.32 per cent of over 1,000 formalin-fixed brains. In no instance was there a cavum Vergae without the simultaneous presence of a cavum septi pellucidi, though the reverse does not hold true. This is an important observation for the roentgenologic differentiation between a cavum Vergae and a cavum veli interpositi. In the absence of a cavum septi pellucidi, an air-filled space behind the foramen of Monro is more likely to be a cavum veli interpositi than a cavum Vergae.

Other conditions which enter occasionally into differential diagnosis are a large suprapineal recess and the frontal sinus. The confusing shadow is first noted in the anteroposterior projection, and, whereas it mimics the cavum veli interpositi, a careful study of the lateral projection indicates its true nature.

The clinical significance of the cavum veli interpositi is not clear. A family history is available for 44 cases, including the present series. Consanguinity between the parents was found twice. A family history of convulsions was obtained in 14 cases. Neurologic disorders, psychoses, and mental retardation have occurred in a number of the affected families. Among 39 cases with known follow-up there were 13 deaths in infancy. The causes of death were: cardiac arrest during craniotomy, cerebral phlebothrombosis, tuberculous meningitis, bronchiolitis, and diffuse sclerosis. Other deaths were due to convulsions and hyperpyrexia. Recent experiences indicate that the anomaly does not necessarily carry a serious prognosis, since it is encountered occasionally in patients with normal intelligence and without any serious brain defects.

Twenty roentgenograms.

NORMAN L. ARNETT, M.D.
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On Ten Cases of Cerebral Cysticercosis. C. Vatopoulos and D. Cotsilimbas. Evangelismos Hosp. Rev. **22:** 645–659, 1960. (Evangelismos Hospital, Athens, Greece)

Ten cases of cerebral cysticercosis were found among 1,000 patients operated upon for cerebral tumors. In only 1 instance was the diagnosis established preoperatively. Clinically, the patients suffered from epileptic seizures of jacksonian or of general type, followed by a stage of increased intracranial pressure. The cerebrospinal fluid showed an increase in proteins, as well as cells, with a picture of lymphocytosis. According to the authors, the increased intracranial pressure is due to cerebral edema caused by the parasite toxins, and death may follow occlusion of the duct of Sylvius or the fourth ventricle.

Radiologically, plain films of the skull revealed no evidence of calcification. Air studies showed mostly nonspecific signs, such as hydrocephalus and displacement. Fillipov's sign, however, was positive in 3 cases. This, according to the authors, consists in small round opacities located at the periphery of the air shadow of the subarachnoid spaces or on the walls of the air-filled ventricles. It is due to the protrusion of the cysts into the air pattern of the brain during ventriculography or encephalography.

There was a discrepancy between the severity of the increased intracranial pressure and the relatively minor neurological and ventriculographic findings.

Four photographs. C. G. PAPAVASILIOU, M.D.
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Encephalography in the Arnold-Chiari Malformation. Bengt Liliequist. Acta radiol. **53:** 17–32, January 1960. (Serafimerlasarettet, Stockholm, Sweden)

The encephalographic appearances of herniated cerebellar tonsils in the presence of intracranial expanding lesions and of deformed tonsils in the Arnold-Chiari malformation are described on the basis of 40 cases of the former (known posterior-fossa tumors) and 16 cases of the latter.

Both herniated cerebellar tonsils and the Arnold-Chiari malformation may be demonstrated with certainty by lumbar encephalography, which is the safest and most accurate method for examination of the subarachnoid spaces immediately below the foramen magnum. The Lindgren technic is used. If changes are suspected in this region, the examination is begun with sharp forward flexion of the head, to arrest the air in the upper cervical subarachnoid space. The central ray is directed at the first cervical vertebra. The first roentgenogram is taken after injection of air without withdrawal of fluid.

When the cerebellar tonsils were herniated, their inferior poles usually were rounded and completely or nearly filled the subarachnoid spaces in and below the foramen magnum. The further down the tonsils extended, the more pointed was the appearance of the inferior poles. In such cases, changes were always found in the intracranial fluid spaces. There were two roentgenologic features characteristic of the Arnold-Chiari deformity: narrowing and elongation of the tonsils and prolongation of the fourth ventricle, with the foramen of Magendie located below the foramen magnum. The first of these signs was present in every case, and the latter was indirectly established in 10 cases by demonstration of the foramen of Magendie as a straight strip of air anterior to the deformed tonsils. Because the tonsils are closely applied to the medulla spinalis, an intramedullary expansive process cannot be ruled out unless air can be seen between the tonsils and the medulla or in the foramen of Magendie. This was a problem in one case.

Thirteen roentgenograms; 8 diagrams.

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Roentgenologic Study of the Vascular Markings of the Skull. Constantine S. Soter and John H. Gilmore. Am. J. Roentgenol. **82:** 823–829, November 1959. (Illinois Masonic Hospital, Chicago, Ill.)

The purpose of this paper is to review the known information about vascular markings in the skull and to present 2 cases with interesting observations. The vascular markings as seen roentgenographically can be separated anatomically into two categories: (1) markings due to the diploic vessels; and (2) markings of branches of meningeal arteries and veins.

The brain and overlying structures have three vascular systems: (1) cerebral and cerebellar, (2) meningeal-osseous, and (3) superficial system for soft parts and bone. The first system is not visualized in the plain roentgenograms of the skull. The most important vessels of the meningeal-osseous system are the middle meningeal arteries and veins and the diploic veins. The third system consists of subcutaneous arteries and veins and vessels of muscles and the periosteum.

The middle meningeal artery, a branch of the internal maxillary artery, is one of the most important arteries of the cranium. Its channel is the most consistently

visualized on skull roentgenograms and a detailed study of it should always be undertaken. It enters the skull through the foramen spinosum, the size of which is an indication of the size of the artery. A difference of more than 2 mm. in diameter between the foramina should be considered significant. The groove of the middle meningeal artery is discernible on roentgenograms after the age of two years. Any marked difference in the size of the grooves on the two sides should be considered abnormal.

The sphenoparietal sinus groove is posterior to the coronal suture and terminates in the cavernous sinus. It is straight and conspicuous but occasionally may cause difficulty in identification and differential diagnosis.

The lacunae or venous lakes are caused by enlargement of the meningeal veins in the parasagittal area and communicate with the cerebral veins. They develop after birth. The lacunae show considerable variation and usually have no diagnostic pathologic significance.

The diploic veins vary considerably in number, size, and distribution. The size and number of the canals are not related to the thickness of the bone or the consistency of the diploe. There are no veins in the squamous portion of the temporal bone because it is devoid of diploe.

Many of the canals and foramina which connect the cranial cavity with the exterior soft parts contain veins to which the designation "emissary" is applied. They are usually small, and the majority are without diagnostic significance because the changes in size cannot be observed roentgenographically. The most important exception is the occipital emissary vein.

The pathologic changes of the vascular markings can be divided into two groups:

(1) Decrease of the size of the diploic markings or their complete obliteration, which occurs occasionally when a tumor is peripheral and produces direct pressure on the vessels. The decreased diploic markings may be seen in deep-lying and slowly growing tumors as a manifestation of increased intracranial pressure; rarely, in hydrocephalus.

(2) Widening, enlargement and tortuosity of the diploic markings: Widening of the occipital emissary vein with a large defect in the midline of the occipital bone has been observed in slowly growing tumors with increased intracranial pressure. It appears as a round or funnel-shaped defect in the external table of the calvaria in the region of the occipital protuberance. One must differentiate this widening from pacchionian depressions and defects due to erosion of bone by tumor. Also, in advanced age the normal emissary foramen may appear wider.

The meningiomas, particularly of the parasagittal area, are notorious for the high incidence of widened grooves of the middle meningeal arteries. It is known that the blood supply of these tumors is dual. The external carotid artery, through the middle meningeal, supplies the center of the tumor. The internal carotid artery supplies the peripheral part. Widened and often markedly tortuous grooves belonging to tributaries of the middle meningeal artery may be seen leading to the tumor area from this region. Large collecting venous channels are usually present extending into the adjacent areas.

Prominent vascular markings are also observed in meningiomas of the convexity, wings of the sphenoid, and olfactory groove.

Arteriovenous malformations or true hemangiomas may show vascular markings indistinguishable from those of meningiomas; usually, the prominent vascular markings not only have diagnostic value but also help to determine the location of the tumor.

Widening of the foramen spinosum is of great diagnostic value when it occurs. It assists in the evaluation of the vascular markings, particularly when the changes are slight, and in determining that the groove is arterial. When widening of the meningeal arterial grooves and of the ipsilateral foramen spinosum is demonstrated, one may almost certainly ascertain that one of two lesions is present: (*a*) convexity or parasagittal meningioma or (*b*) arteriovenous aneurysm involving the middle meningeal and cerebral vessels.

It may be difficult on occasion to differentiate between an abnormally wide arterial channel and an insignificantly prominent diploic vein. In these cases advantage should be taken of the frequently forgotten anatomic fact, mentioned above, that the squamous portion of the temporal bone has no diploe.

Six roentgenograms.

NORMAN L. ARNETT, M.D.
Anaheim, Calif.

Skull Changes in Infants with Chronic Iron-Deficiency Anemia. Nasrollah T. Shahidi and Louis K. Diamond. New England J. Med. **262:** 137–139, Jan. 21, 1960. (Harvard Medical School, Boston, Mass.)

The occurrence of skull changes in association with congenital hemolytic disorders has been known for over thirty years. These changes consist of widening of the diploic spaces, atrophy of the outer table, and numerous fine perpendicular striations. Delay or lack of pneumatization of air sinuses may also be seen. The aim of this report is to record identical changes in infants with chronic iron deficiency and to discuss briefly their significance.

The authors had an opportunity to observe 3 infants eight and twelve months of age (2 were twins), who had been on a diet consisting mainly of milk, with a consistently poor intake of solids and soft solids. In addition to marked pallor of the skin there was noticeable bossing of the frontal and parietal bones of the skull. Hepatosplenomegaly was also noted. A complete hematological work-up established the diagnosis of iron-deficiency anemia in all 3 cases. Radiographic study showed typical changes in the skull previously thought to be associated with hemolytic anemias only. The roentgenograms of the long bones failed to reveal any abnormality.

The abnormalities in the skull and long bones of patients with erythroblastic anemia are thought to be the result of bone-marrow overgrowth. It is likely that the same mechanism is involved in infants with chronic iron-deficiency anemia. The fact that the latter condition, even in premature infants, does not usually develop before two months may explain the fact that the radiographic findings are limited to the skull: it may be that the cortices of the long bones do not allow easy expansion of the bone marrow, whereas those of the frontal and parietal bones offer no resistance at this stage of development. A repeat roentgenogram of the skull of one of the patients taken six months later disclosed no change from the admission film.

Two roentgenograms; 1 table.

MAJ. MARTIN A. THOMAS, M.C.
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A Cineradiographic Study of Postresectional Alterations in Oropharyngeal Physiology. Donald P. Shedd, James A. Scatliff, and John A. Kirchner. Surg., Gynec. & Obst. **110:** 69–89, January 1960. (Yale University School of Medicine, New Haven, Conn.)

This study is concerned with cinefluorographic investigation of the dynamics of swallowing in a group of 11 patients with surgical alterations of certain structures of the upper digestive tract.

The cinefluorographic examinations were done with a Philips image intensifier and a 35-mm. Arriflex camera, at a rate of 24 frames per second. The 35-mm. film was subsequently optically printed on 16-mm. film for study in an analyzing projector. The patients were examined in the upright position after ingestion of 30 to 45 c.c. of thick barium mixture. The camera was centered on the oral cavity for the first swallow and during subsequent swallows was directed toward the hypopharynx, after which the bolus was followed in its further downward course. Films were taken in both lateral and anteroposterior projections.

Two tables summarize the surgical alterations and the relationship between the operative procedure and cinefluorographic findings.

The authors describe the present concepts of normal buccopharyngeal deglutition: three stages—oral, pharyngeal, and esophageal—are recognized.

The clinical status, cinefluorographic findings, and interpretations and the conclusions arrived at for each patient are presented. The most important impressions regarding both normal and abnormal functions are summarized in the authors' conclusions:

1. There is evidence of a reciprocal role of the tongue and mylohyoid muscle in the oral stage of swallowing.

2. The posterior portion of the tongue makes a significant contribution to the competency of faucial closure. When there is sufficient alteration in that part of the tongue, there may cease to be a separate oral phase of swallowing, the mouth then serving only as a passive conduit.

3. The posterior portion of the tongue also supplements the action of pharyngeal constrictors in the pharyngeal phase of swallowing.

4. Evidence is presented as to the relative importance of ascent of the hyoid-larynx column as opposed to intrinsic sphincteric closure of the larynx in airway protection during swallowing.

5. The importance of the superior laryngeal nerve and the motor pharyngeal branches of the vagus in deglutition is demonstrated.

The cinefluorographic studies reported here have shown that there is a wide margin of reserve by which compensation for impairment can occur.

Eleven roentgenograms with accompanying diagrams; 2 tables. ROMAN MARCINIAK, M.D.
University of Pennsylvania

THE CHEST

Radiologic Aid in Regional and Generalized Emphysema of the Lungs in Infants. Edwin J. Liebner. Pediatrics **24:** 1050–1064, December 1959. (1853 West Polk St., Chicago 12, Ill.)

Excessive aeration of an infant's lungs presents a critical diagnostic problem. In order that the proper surgical measure may be instituted, it is essential that as much information be obtained preoperatively as possible. In this paper discussion is limited to the following representative conditions:

I. Lung
  A. Obstructive Emphysema
    1. One lung
      a. Intraluminal—foreign body
      b. Extraluminal—corynal cyst
    2. Regional
      a. Pneumatoceles
      b. Lobar emphysema
      c. Congenital cystic disease
  B. Compensatory Emphysema
    1. Whole lung
      a. Bronchiolitis
    2. Regional
      a. Intraluminal—secretions, atelectasis
      b. Extraluminal—lymph nodes
II. Pleural Space
  A. Total
    1. Pyopneumothorax
  B. Regional
    1. Basal pneumothorax

A case illustrating each of the above conditions is reported, with a comment on the roentgenologic findings.

Twenty-nine roentgenograms; 2 tables.

A Contribution to Bronchiolitis Obliterans. W. F. Diller and H. Hillger. Schweiz. med. Wchnschr. **90:** 91–94, Jan. 23, 1960. (In German) (Stadtkrankenhaus Rüsselsheim/Main, Germany.)

The authors report a case of bronchiolitis ob'iterans ending in death and compare their findings with those in 51 cases from the medical literature. Exceptional features in the present instance were the advanced age of the patient (forty-one years), the absence of preliminary pulmonary or bronchial disease, and the rapid deterioration within seven days. Roentgenologically the symmetrical enlargement of the lung hili due to engorgement of the pulmonary circulation is considered important in differential diagnosis.

One roentgenogram; 2 photomicrographs; 1 chart.

Kerosene Pneumonitis. Jack Reynolds and Frederick J. Bonte. Texas State J. Med. **56:** 34–38, January 1960. (5201 Harry Hines Blvd., Dallas 19, Texas)

Intoxication from the ingestion of kerosene is a leading form of accidental poisoning in the younger age group and is particularly frequent in the South. Of major importance is the chemical pneumonitis present in the vast majority of cases, which is probably caused by aspiration. This largely determines the severity of the clinical course.

Fifty-two patients, ranging in age from thirteen to seventy-two months, were observed in the emergency facility of the Parkland Memorial Hospital, Dallas, during 1952 through 1954 and in 1956, following the ingestion of kerosene. In 47 of these, one or more chest roentgenograms were obtained and these are the cases included in this study. All of this group survived. There was a positive correlation between the amount of kerosene ingested and the severity of clinical symptoms, extent of pulmonary infiltration shown on the roentgenogram, and duration of hospitalization.

The distribution and appearance of the infiltration on

chest films were believed to be characteristic of kerosene pneumonia. Aside from a somewhat uncommon variant which may reflect pulmonary changes due to the blood-borne kerosene, the fundamental picture suggests an aspiration pneumonia with involvement of dependent segments. The most common distribution was bilateral basal (36 patients). In 5 patients there was involvement of the right base only; 3 showed a hazy, confluent bilateral perihilar infiltration with clear lung bases. This was termed the "edema" type and may well be a manifestation of the fundamental lesion produced in all organs when absorption from the gut is of sufficient magnitude and the blood-borne poison alters vascular permeability with resultant fluid extravasation and edema. Four other patients whose major lung lesions were bilateral basilar infiltrations had evidence of an "edema" type of pattern combined with the common "aspiration" appearance. One of these patients was known to have consumed as much as 200 c.c. of kerosene.

Characteristically, roentgen evidence of resolution of infiltration lagged well behind clinical improvement, persistence of pulmonary opacities being not unusual on films taken ten or twelve days after the initial examination.

In 15 patients the interval between ingestion of kerosene and radiography of the chest was reliably documented and found to be less than an hour. All showed evidence of pneumonia. Experiments were undertaken to determine the minimal interval at which an infiltrate could be detected and to depict the rate of development of pneumonic consolidation after the deposition of kerosene in the lung. A time-lapse cineroentgenogram made after the instillation of 15 c.c. of kerosene through a catheter into the right lung of a dog showed a definitely visible infiltrate in fifteen to twenty minutes. The process increased steadily in size until the death of the animal at three hours.

Fourteen roentgenograms.

Bilateral Pulmonary Aspergilloma and Pulmonary Moniliomas. K. Vlakhov and M. Karparov. J. de radiol. **41:** 34–38, January-February 1960. (In French) (Plovdiv, Bulgaria)

The present report of 3 cases (1 aspergilloma, 2 moniliomas) seeks to call attention to an etiologic possibility in the differential diagnosis of hemoptysis.

The first case, of bilateral pulmonary aspergilloma, is of interest because of the symmetrical nature of the lesions in both upper lungs, which is an extremely rare picture. According to Quillec (J. franç. méd. et chir. thorac. **12:** 228, 1958), only 3 examples of bilateral aspergillomas have been reported in the world literature. Another interesting point in this case was the fact that, during the last year, the hemoptysis had occurred two or three days before the menstrual periods, concomitantly with an eczema of both hands, all these phenomena vanishing with the termination of the menses. It seems likely that here we are dealing with periodic hormonal influences on the reaction to the mycotic agent, a kind of allergy. This theory appears to be supported by 1 of the 2 cases of pulmonary monilioma, in which the hemoptysis was also related to menstruation.

Seven roentgenograms with accompanying diagrams; 2 photomicrographs.

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THE HEART AND BLOOD VESSELS

Intravenous Aortography: Its Clinical Application. Eugene F. Bernstein, Richard H. Greenspan, and Merle K. Loken. Arch. Surg. **80:** 71–78, January 1960. (University of Minnesota Medical School, Minneapolis, Minn.)

The complications associated with the translumbar and other direct arterial approaches to aortography and the low incidence of allergic reactions to the newer opaque media warrant the consideration of a venous approach to opacification of the aorta and its branches. Intravenous aortography represents an extension of the technic of angiocardiography as originally developed by Robb and Steinberg. It may be supplemented by nephrography and nephrotomography.

Under local anesthesia a polyethylene catheter is introduced into the median antecubital vein and advanced to the axilla. A preliminary injection containing 50 microcuries I^{131}-labeled Renografin, 2 c.c. stable Renografin, and 75 c.c. saline is made. Radioactivity over the abdominal aorta is recorded and the arm-to-aorta circulation time is measured to indicate the interval to be allowed between the main injection of contrast material and the first x-ray exposure. The main injection consists of 75 to 90 c.c. of 85 to 90 per cent Hypaque or Renografin delivered with the aid of a steel syringe in a simple lever hand injector. Film exposures are made at the rate of one per second, in two planes, for five to ten seconds, with a Schönander biplane rapid changer.

This procedure has been most useful in the pre- and postoperative evaluation of patients with known or suspected abdominal aortic aneurysms. It has also been employed for study of the thoracic aorta although in these instances determination of radioactive circulation times was not required. Aortic occlusions and a variety of renal lesions have been studied. In 110 patients, 122 aortograms were obtained without death or serious complication. Films of diagnostic quality were secured in over 90 per cent of cases.

The intravenous approach obviates the disadvantages of the arterial puncture technic, *i.e.*, the danger of hemorrhage, superior mesenteric or renal arterial thrombosis, embolism, renal insufficiency, paraplegia, aortic dissection, hemo- and chylothorax, pancreatitis, and adrenal necrosis. General anesthesia is not required.

In the accompanying discussion Steinberg describes the method of intravenous abdominal aortography using the Decholin circulation time, bilateral manual injection into the large arm veins and the use of standard roentgen apparatus with a two-second exposure of a single film for visualization of the entire abdominal aorta and its branches. With a portable machine, films are also exposed for two-seconds at the completion of the abdominal study, for visualizing the peripheral vascular circulation.

Twenty roentgenograms; 1 photograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Peripheral Arteriography Utilizing Image Amplification and Cinemaroentgenography. Robert I. Lowenberg and Robert M. Lowman. Arch. Surg. **80:** 80–86, January 1960. (245 Edwards St., New Haven, Conn.)

The place of arteriography in the work-up of the patient with advanced peripheral vascu'ar disease has

been established. Many technics have been employed, but serial-film, split-film, and moving-tube procedures all have their disadvantages. The authors use image amplification and cinemaroentgenography.

The main advantage of the latter technic is that it avoids nonvisualization of the outflow tract beyond an occlusive lesion. The patency of the vascular tree distal to an obstruction is most important in determining the success of operative intervention. With the image intensifier, a small dose, about 5 c.c., of opaque medium is followed down the limb and the general arterial distribution is noted. A second run is then made with 10 to 20 c.c. of medium, and a cine record is made under fluoroscopic guidance. Special attention is directed to suspicious areas, and the largest number of feet of film will be taken in the area of the greatest pathologic change. The dynamics of the circulation may thereby be recorded and details may be obtained which cannot be visualized in serial-film studies.

Six cases are reported.

Twelve roentgenograms.

JOHN F. RIESSER, M.D.
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Definitive Treatment of the Post-Thrombotic Syndrome. The Use of Venograms to Differentiate and Delineate Surgical Treatment. Gerald H. Pratt. Arch. Surg. **80:** 112–118, January 1960. (20 E. 68th St., New York 21, N. Y.)

Patients with the post-thrombotic syndrome fall into three groups: Those in the first group have large, white legs with causalgic syndromes. Patients in the second group have functioning recanalized, deep veins again, but show massive superficial varicosities. In the third, and largest group, chronic and recurring ulcers predominate.

All of the 203 patients, on whom the author's remarks are based, were treated by hospitalization and conservative therapy. One-third responded to these measures. In two-thirds an operation was required. This surgery must be delayed until venograms show functioning deep veins and reveal the local venous and shunt pathology. In addition, in the ulcer group, where there are numerous shunts and arterial varices, venograms serve as a guide to the excision of the ulcers and their underlying varicocele-like vessels. Venography also demonstrates the deep vein function and shows the sites for excision.

Four roentgenograms; 4 photographs; 5 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Cine-Angiography of the Coronary Circulation in Living Dogs. Graeme Sloman and Keith Jefferson. Brit. Heart J. **22:** 54–60, January 1960. (K. J., St. George's Hospital, London, England)

The authors report an investigation done to find the most efficient and safe method of coronary angiography in animals (20 mongrel dogs) with a view to applying it to human subjects. A cardiac catheter was passed through the right common carotid artery into the ascending aorta, and a second catheter *via* the left femoral artery into the thoracic aorta. The latter catheter measured the central aortic pressure; the former was used for injection of contrast medium (75 per cent Urografin and 90 per cent Hypaque). Cineangiographic recordings were made on 35-mm. film from a Philips 5-inch image amplifying tube, at 32 frames per second, 10 ma. and 70 kv.

For injection of the medium a Lehman catheter with a wide bore (7F) and the end hole plugged gave best results. The best catheter position for filling the coronary arteries was with the tip about 2 cm. above the aortic valve. With cardiac arrest, the position of the catheter was not critical. Equally good filling was obtained with the tip just above the aortic valves, in the aortic arch, or in the descending thoracic aorta.

Rapid injection of the contrast agent was found to be very important, since good coronary filling occurred only when the injection took one second or less.

In order to reduce the dissipation of contrast medium down the thoracic aorta, the effects of increasing the intrathoracic pressure, the Valsalva maneuver, drug-induced bradycardia, and cardiac arrest with acetylcholine (5 mg.) were studied. The best results were obtained with injection during cardiac arrest.

It is thought that this method of angiography may be applicable to study of the coronary circulation in man.

Four roentgenograms; 3 electrocardiograms.

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THE LYMPHATICS

Studies of Ulceration and Edema of the Lower Extremity by Lymphatic Cannulation. T. G. Blocker, Jr., James R. Smith, E. Frank Dunton, Jacob M. Protas, Robert M. Cooley, Stephen R. Lewis, and E. J. Kirby. Ann. Surg. **149:** 884–896, June 1959. (University of Texas Medical Branch, Galveston, Texas)

Considerable confusion still exists as to the anatomy and hydrodynamics of the lymphatics of the extremities in both normal and pathologic states. The authors performed cannulation studies on 65 persons, including 25 normal patients, and did 35 experiments on dogs. Intralymphatic pressure determinations were also carried out with sensitive electronic equipment, and lymphangiograms were made following injection of contrast material (50 per cent Miokon). Lymph flow studies from the foot to the thoracic duct were conducted in 3 patients undergoing neck surgery, with the use of tagged protein, and, in these, pressures within the thoracic duct and jugular vein were measured. Additional studies in the dog included observation of the effects of trauma and of simulated altitude with a standard pressure chamber.

In the lymphangiogram the superficial lymphatics in the normal leg appear as small channels of uniform diameter (the size of a No. 27 needle shaft) with characteristic beading at the site of valves approximately 1 cm. apart. The vessels bifurcate and communicate with one another by anastomosing branches but do not increase in size as they approach the inguinal region, where they enter the lymph nodes by separate routes rather than by converging into larger vessels. At times the individual channels bypass the lower nodes and enter the higher ones directly. The inguinal nodes are distended by the contrast medium but are not palpable; they have a solid appearance under normal conditions, and no internal detail can be visualized. Connections are seen between the lower and higher nodes, and efferent vessels enter first the iliac nodes and then empty into the lumbar trunks. There is no established number of lymphatic channels on the dorsum of the

foot; they average from three to five, but as few as one or two have been observed. At the ankle, additional channels are seen, and they become more numerous at the knee. As the lymphatics pass upward they follow the general course of the great saphenous vein.

The presence of edema fluid in the leg influences markedly the pattern of the lymphatic structures as seen on radiologic examination. Either more channels appear or vessels are dilated, with incompetency of valves, as indicated by lack of beading and retrograde flow of Miokon, which does not ordinarily occur. The transient increase in size of capillary lymphatics in the presence of edema has been considered by some to be a passive dilatation produced by the effect of increased tension on the connective-tissue attachments of the lymphatics to the surrounding structures; the same mechanism must affect the larger structures which lie along the fascial planes of the muscles of the leg and thigh.

The procedures described were found to provide a reliable method of investigating some of the pathological physiologic changes which occur in the so-called lower leg syndrome and in other abnormal states. Studies in normal subjects and in normal extremities of several patients with involvement of the lymphatics on one side, as well as those in dog limbs, demonstrated that intralymphatic pressures are characteristically subatmospheric. Pressure becomes atmospheric or positive with edema, blockage of the lymphatic channels by scar tissue, or removal of the inguinal nodes; and, at least in the dog, following acute trauma and anoxia. There seemed to be some correlation, in the authors' series, between the degree of positive pressure and the severity of the lesion. The rapidity with which changes occur following acute injury in the experimental animal and the absence of pathologic findings in those leg ulcer patients whose swelling has subsided on bed rest and elevation suggest that chronicity *per se* is not the dominant etiologic factor in the production of lymphedema unless congenital developmental anomalies are present. Fairly rapid lymph drainage does occur in the normal patient at complete rest and in the horizontal position.

Eleven figures, including 7 roentgenograms.

THE DIGESTIVE SYSTEM

Leiomyoma of the Esophagus. Allan E. Green, Jr., Byron G. Brogdon, Neil E. Crow, and Alfred G. Swearingen Am. J. Roentgenol. **82:** 1058–1062, December 1959. (Lackland Air Force Base, Texas)

Leiomyoma is the most commonly diagnosed benign tumor of the esophagus. Prior to 1948, only 16 cases were recognized, surgically treated, and reported. This number has now been increased by over 100. Five cases are presented in this paper, and the clinical and roentgenologic features, ease of diagnosis, and amenability to surgical treatment are considered.

Esophageal leiomyoma is encountered more frequently in males. The average age of occurrence is about forty although 3 of the authors' patients were in their early twenties. Dysphagia is ordinarily the most common symptom, but in the 3 of the cases recorded here there were no complaints referable to the alimentary tract. The tumor commonly is located in the lower or middle third of the esophagus. Its growth may be intramural or intraluminal. The characteristic roentgen finding is a segmental intramural filling defect in the barium-filled esophagus, with intact overlying mucosa. Proximal dilatation occurs in most cases.

Surgical enucleation is the treatment of choice unless the mass is very large or is located at the esophagogastric junction, when excision may be necessary.

Eight roentgenograms.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Sideropenic Webs in Men. F. J. Brunton and R. E. Eban. Clin. Radiol. (J. Fac. Radiologists) **11:** 65–67, January 1960. (St. Mary's Hospital, London, W. 2, England)

The authors describe 4 cases of sideropenic webs in men visualized radiologically and briefly review the literature. All 4 patients were found to be suffering from iron-deficiency anemia. The webs were in the cervical esophagus, and both anteroposterior and lateral projections proved valuable in their demonstration.

In view of the known association of sideropenic webs and malignant disease, they should be suspected and sought for in the post-gastrectomy or post-gastro-enterostomy patient with dysphagia.

Six roentgenograms. THEODORE E. KEATS, M.D.
University of Missouri

Increased Distance Between the Diaphragm and the Gastric Fundus on the Roentgen Picture. Cause and Simulation. F. Longin and R. Schehl. Fortschr. a. d. Geb. d. Röntgenstrahlen **92:** 20–33, January 1960. (In German) (Med. Poliklinik der Universität, Würzburg, Germany)

In approximately 10,000 cases examined during a four-year period, observations were made on the distance between the diaphragm and the gastric fundus as demonstrated roentgenologically. The so-called diaphragmatic shadow normally measures 4 to 7 mm. and in maximum inspiration, due to the contraction of the muscles, may be widened up to 1 cm.

The authors discuss the causes of an increased fundus-diaphragm distance under the following headings.

(*a*) *Tumors:* In the presence of a tumor not only is the distance increased but the gastric wall is thickened. The markings are irregular and deformed, and there are also changes in the relief pattern of the mucosa.

(*b*) *Spastic Diminution of the Upper Pole of the Stomach:* Sometimes it is difficult to differentiate a malignant process of the cardia from other conditions. With strong spastic contractions the *magenblase* is small and there is a relative increase of the distance between the diaphragms and stomach. Additional studies with "air" usually help in the differential diagnosis.

(*c*) *Interposition of the Left Lobe of the Liver:* In some cases the left lobe of the liver, as proved by cholangiography and splenoportography, can reach the left lateral chest wall. In such cases interposition between the stomach and diaphragm is possible.

(*d*) *Interposition of the Spleen:* This is much more common than interposition of the liver. Partial interposition produces a characteristic deformity of the upper pole of the stomach. Cardiospasm, stenosis, and esophageal reflux, due to the changes in the esophagogastric angle of His, may result.

(*e*) *Ascites:* Free intra-abdominal fluid tends to sepa-

rate the organs. The small intestinal loops are especially easily separable and their appearance, therefore, is characteristic for ascites. When the free fluid is present between the stomach and the diaphragm, the distance between the two is increased, as is easily demonstrated on lateral films taken with the patient recumbent. Zuppinger demonstrated that the distance in inspiration decreases at least 1 cm., because of the negative pressure in the upper abdomen.

The left diaphragmatic shadow can appear widened with heart enlargement and with partial relaxation of the dorsal portion of the diaphragm. Planigraphy is helpful in differential diagnosis. In doubtful cases diagnostic pneumoperitoneum should be used.

Eighteen roentgenograms; 2 diagrams.

ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Ward Barium Meal Examination in Acute Gastro-Intestinal Haemorrhage. Dermot F. Cantwell. Clin. Radiol. (J. Fac. Radiologists) **11:** 60–64, January 1960. (St. Vincent's Hospital, Dublin, Ireland)

The author discusses his technic of emergency barium meal examination in acute gastrointestinal hemorrhage, performed on the ward. Two hundred patients with gastrointestinal bleeding have been investigated by this method. The examination is carried out with a standard mobile apparatus, with the patient in bed. Diagnosis has been accurate, as confirmed by the usnal procedures, in 82 per cent of the patients. The information gained can be of help when emergency surgery is undertaken. The procedure is not disturbing to the patient and has been free from complications.

The technic is as follows: Food is withheld for two hours. Four to five ounces of barium are given and the patient is rolled on the right side for a few minutes. The first film is taken with the patient supine on the cassette. A mobile x-ray apparatus is then positioned over the bed and just before the exposure is made a mouthful of thick barium is swallowed, which serves to outline the esophagus. The second projection, an oblique prone film, is then obtained, with the left side raised 30°. By propping the patient up on his left side, the duodenal loop is opened and the posterior lying duodenal cap is rendered visible. As gastric evacuation is rapid, both films must be taken within four minutes of swallowing the barium. The upper gastrointestinal tract thus demonstrated includes the lower esophagus, stomach and duodenum.

Five roentgenograms; 2 photographs; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Lesions of the Cardiac End of the Stomach Simulating Carcinoma. George T. Wohl and Leah Shore. Am. J. Roentgenol. **82:** 1048–1057, December 1959. (VA Hospital, Philadelphia 4, Penna.)

Appearances simulating carcinoma at the cardiac end of the stomach may be produced by (1) normal variance of contour; (2) intrinsic benign gastric lesions; (3) pressure deformities from extrinsic causes. Proved examples of these conditions are presented and illustrated, with a discussion of the characteristics permitting differentiation from carcinoma.

The authors stress the importance of exposure of the air-distended cardiac end of the stomach in the erect position for determination of the distance between the diaphragm and stomach. This space normally measures 5 to 15 mm. An increase in its width can be due to disease but may be the result of incomplete distention of a normal stomach. The air swallowed during ingestion of the barium meal is usually sufficient for adequate distention. If, however, only a small amount of air enters the stomach, or if a mass is suspected, larger amounts of air must be introduced. Various methods of achieving this are mentioned.

Twenty-two roentgenograms; 1 table.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Incarceration of the Stomach in an Inguinal Hernia. Report of a Case. Arthur G. Ship, Arthur H. Glick, and Alvin B. Goldenson. New England J. Med. **262:** 78–80, Jan. 14, 1960. (Montefiore Hospital, New York, N. Y.)

A case of incarceration of a huge obstructed stomach in a large left scrotal hernia is reported in an eighty-three-year-old man. Review of the literature discloses 40 other recorded cases, only 3 appearing in American journals.

The presenting signs and symptoms in this case are readily explained by the characteristic anatomic findings. The hernial ring, although large, caused obstruction of the stomach, with a large, fluid-filled, incarcerated portion of the stomach distal to the ring (which was transilluminated and suggested a hydrocele). This high obstruction was manifested by persistent vomiting and the absence of any gas patterns in the scout film of the abdomen. Not until radiopaque material (Gastrografin) was introduced into the stomach was the true nature of this area of obstruction appreciated.

In cases in which there are clinical signs of high gastrointestinal obstruction along with incarcerated inguinal or femoral hernia, opacification of the stomach is recommended as necessary for a diagnosis. Decompression of the stomach prior to operation greatly increases the likelihood of a successful surgical result.

Two roentgenograms.

MAJ. MARTIN A. THOMAS, M.C.
Lackland AFB, Texas

Redundant Duodenal Mucosal Folds and Retrograde Prolapse Through the Pylorus. Karl Mendl and Mary E. Sharp. Brit. J. Radiol. **33:** 36–42, January 1960. (Morriston Hospital, Swansea, Wales)

Two cases of congenital duodenal valve formation are reported. One patient, a 59-year-old woman, gave an eighteen-month history of intermittent pyloric obstruction and hemorrhage. Roentgen study showed two well defined filling defects in the duodenum, one of which was seen to prolapse in a retrograde fashion through the pylorus into the gastric antrum. At operation three hypertrophic mucosal folds were found in the supra-ampullary part of the descending portion of the duodenum. These are described histologically as consisting of "excessive tissues wrongly arranged and conforming to the meaning of the term hamartoma." The proximal fold showed sliding retrograde prolapse through the pylorus.

The second case, in a girl of eighteen years without symptoms, was unproved but was probably an ordinary incomplete diaphragm in the duodenum.

The authors were unable to find in the literature reports of any case similar to their first one, documented radiologically and pathologically.

Eight roentgenograms; 2 photomicrographs; 4 photographs.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Similarities of Mechanical Intestinal Obstruction and Aganglionic Megacolon in the Newborn Infant. A Review of 64 Cases. Orvar Swenson and Franklin Z. Davidson. New England J. Med. **262:** 64–67, Jan. 14, 1960. (Tufts University School of Medicine, Boston, Mass.)

Aganglionic megacolon in the neonatal period may present as an acute intestinal obstruction and be difficult to differentiate from ileal atresia, meconium ileus, and other more common causes of bowel obstruction of the newborn. The plain films can show the presence of obstruction, but barium contrast studies of the colon are needed to demonstrate an enlarged colon proximal to a narrow aganglionic segment. Both false negative and false positive radiographic findings are possible. The only certain method of diagnosis is rectal biopsy which the authors recommend in all cases of suspected neonatal megacolon. The treatment of choice is colostomy as soon as the diagnosis is established. Resection of the aganglionic segment is delayed until the child attains a weight of 20 to 30 pounds.

Two roentgenograms; 2 tables.

MAJ. MARTIN A. THOMAS, M.C.
Lackland AFB, Texas

Radiological Study of the Postoperative Recurrence of Carcinoma of the Colon on the Suture Line of the End-to-End Anastomosis. S. Benetatos. Galenos **2:** 588–605, 1960. (Malmö Almänna Sjukhus, Malmö, Sweden)

This paper is based on 24 cases of carcinoma of the colon treated surgically by segmental resection and end-to-end anastomosis and followed radiographically.

The author at first discusses briefly the pathogenesis of recurrence. He considers the most likely hypothesis to be the implantation of neoplastic cells during operation. The radiographic anatomy of the postoperative colon is also briefly considered.

A routine postoperative barium-enema study is done four to eight weeks after the operation, to serve as a base line for comparison with subsequent barium-enema examinations performed quarterly. Double air-contrast technic is preferable since it gives a greater possibility of an earlier detection of recurrence.

In 11 patients there was a recurrence of the tumor seven to twenty-four months after operation. In 8, the recurrence was located at the site of the anastomosis; in the remainder, other parts of the colon were involved. In 5 of the 8 patients the recurrence was detected radiologically, in 2 it was revealed after surgical exploration, and in 1 postmortem. The author describes no pathognomonic x-ray findings. Stenosis of the lumen of the colon and irregularity of its contour, as well as a unilateral incisura, as described by Sharpe and Golden, were the most commonly encountered findings. The incidence of radiologically detected recurrent disease was 20.8 per cent. This figure compares favorably with other series as those of Sharpe and Golden (11.1 per cent) and Cronqvist (3.5 per cent); the improvement is attributed to the better delineation of details obtained with the double air-contrast method.

Twenty-nine roentgenograms; 1 photomicrograph.

C. G. PAPAVASILIOU, M.D.
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Fatal Infarction of the Descending Colon After Lumbar Aortography. R. K. Padhi. Canad. M. A. J. **82:** 199–201, Jan. 23, 1960. (Queen's University, Kingston, Ont., Canada)

A case of fatal infarction of the descending colon after lumbar aortography in a 56-year-old male is reported. The needle was inserted immediately above the mouth of the inferior mesenteric artery. Because of a technical error which resulted in nonexposure of the film during the first injection, 2 doses of 70 per cent sodium acetrizoate (Urokon), a total of 60 c.c., were given. Neither of the injections was intramural or periaortic.

Laparotomy, performed five days after aortography and three days prior to death, because of abdominal pain and the appearance of blood and mucus in the stool, disclosed complete thrombosis of the inferior mesenteric artery. The large bowel from the mid-transverse colon to the rectum was gangrenous; this was resected and a transverse colostomy was performed. It is thought likely that the massive necrosis of the descending colon was due to the direct effect of the contrast agent blocking the capillary bed and causing small-vessel thrombosis.

At autopsy the entire aorta down to the femoral arteries was found to be severely atherosclerotic. A firm thrombus completely blocked the left common iliac artery and another partially occluded the right common iliac artery. A lower branch of the left renal artery, that supplying the lower pole, was obstructed by still another thrombus and that portion of the left kidney was infarcted. The right lung was bronchopneumonic, with abscess formation.

Certain precautions are mentioned which will help minimize the frequency of complications following lumbar aortography: (1) Multiple punctures and multiple injections should be avoided. (2) The site of puncture should be either high, *i.e.*, at the level of L-2, or well below the renal arteries. (3) In the presence of a suspected block, smaller amounts of contrast medium—less than 25 c.c.—should be used. (4) Sodium diatrizoate 50 per cent is preferable to more concentrated substances.

Two roentgenograms.

Mucocele of the Appendix. Richard H. Marshak and Arnold Gerson. Am. J. Digest. Dis. **5:** 49–54, January 1960. (1075 Park Ave., New York 28, N. Y.)

A 48-year-old white woman entered the hospital complaining of pain in the right lower quadrant of the abdomen, of four months duration. A short history of intermittent "indigestion" without melena was reported. At physical examination a palpable, smooth, rounded mass, approximately 7 cm. in diameter, was felt in the right lower quadrant. The mass was fixed laterally and was mildly tender. On barium-enema study a broad-based, sharply demarcated, rounded, smooth, filling defect was demonstrated in the medial portion of the cecum. A crescent-shaped zone of calcification was seen along the margin of the defect, which invaginated the cecum. The lateral border of the terminal ileum was slightly flattened and medially displaced by extrinsic pressure. No change in the appearance of the defect was noted on post-evacuation study.

At surgery a mass was found intruding into the lumen of the cecum not appearing inflammatory and mimicking carcinoma. This was excised with a gener-

ous segment of colon. Pathologic studies showed typical mucocele of the appendix with calcification of the cystic wall and obstruction of the appendiceal stoma.

Radiologic features of mucocele of the appendix are nicely demonstrated by this case. They include a sharply outlined, lobular, smooth filling defect of the cecal wall with or without marginal calcification and with nonfilling of the appendix. To be differentiated are inverted appendiceal stump (usually smaller and more irregular), appendiceal abscess (which occasionally cannot be differentiated but is usually associated with spasm and irritability of the adjacent bowel), and carcinoma (usually destroying the mucosa and producing an asymmetrical deformity of the cecum with eccentric lumen). The features under discussion are favorably illustrated by high-quality enlarged roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Opaque Gallstones Showing Pliability During Cholecystographic Visualization. Seymour Fiske Ochsner and Eddie A. Orgeron. Am. J. Roentgenol. **82**: 1024–1027, December 1959. (Ochsner Clinic, New Orleans, La.)

The authors present an unusual case of "pliable" gallstones of calcium density demonstrated roentgenographically prior to surgery. The calcific shadows were not constant but moved about in the gallbladder and cystic duct, changing shape because of the pliable nature of the material of which they were composed. These changes were noted on repeated cholecystograms and following intravenous cholangiography.

After recurrent episodes of colicky pain, a cholecystectomy was performed, yielding a gallbladder containing a mucoid-type of bile, eight cholesterol gallstones, one of which occluded the cystic duct, plus a collection of white, pultaceous material of the consistency of toothpaste, which was opaque. This material is unlike milk of calcium bile because the opacities are paste-like and not of fluid nature. However, they may represent the end-result of bile heavily laden with calcium carbonate which becomes concentrated and assumes a paste-like consistency.

Five roentgenograms; 1 photograph.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

A Case for Routine Operative Cholangiography. Irving Rudman and Merle L. Otto. Illinois M. J. **117**: 12-14, January 1960. (Hedges Clinic, Frankfort, Ill.)

When emergency surgery is performed because of progressive acute cholecystitis in the poor-risk patient, x-ray demonstration of the patency of the cystic duct and definition of the status of the common duct are helpful. Six case reports are given in this article to illustrate otherwise unobtainable information provided by operative cholangiography. In each instance the roentgen data minimized the operating time needed for evaluation of the situation; several times the cholangiogram prevented errors in diagnosis or judgment.

It is emphasized that this technic must be available routinely to exploit its full value in an area notorious for its unpredictable anatomy, complex pathology, and relative inaccessibility. If cholangiography is employed whenever the gallbladder or common duct is opened, the results will be rewarding.

Differential Diagnosis of So-Called Gallbladder Regeneration. E. Nägele and W. Huwe. Fortschr. a. d. Geb. d. Röntgenstrahlen **92**: 65–71, January 1960. (In German) (Med. Poliklinik der Universität Giessen, Germany)

It has been shown in the past that actual regeneration of the gallbladder following cholecystectomy does not occur, though the stump of the cystic duct may show an ampule-like widening, especially when some obstruction exists at the common duct. With today's use of Biligrafin, this matter has come up for reconsideration, especially from a radiologic standpoint. Some observers have thought that the rounded density adjacent to the ductus choledochus demonstrable in postcholecystectomy patients represented the duodenal bulb.

The authors examined 103 cholecystectomized patients roentgenographically, obtaining spot-films in upright and recumbent positions, and in some cases planigrams. In 48 cases a rounded shadow was visible adjacent to the common duct. This proved to represent retrograde filling of the duodenal bulb. In 4 instances a gallbladder-like shadow was demonstrated, which definitely did not represent the duodenum. In 3 of these a long cystic duct was seen containing contrast material, continuous with that in the common duct. In 1 case it was proved histologically that not only the cystic duct but a small portion of the neck of the gallbladder remained after the cholecystectomy.

Correlating this observation with other studies, the authors conclude that in about half of the cases the widening of the stump after cholecystectomy represents the cystic duct; in some it is due to the cystic duct and to a remnant of the gallbladder neck. In the differential diagnosis, atypical duodenal diverticulum, diverticulum of the common duct, double gallbladder, and insufficient removal of the cystic duct, with subsequent formation of a small ampule, are to be considered.

Most cases of a gallbladder-like shadow in the cholecystectomized patient are due to the retrograde flow of contrast material into the duodenum.

Twelve roentgenograms; 1 drawing.

ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

THE DIAPHRAGM

Roentgenologic Diagnosis of Rupture of the Diaphragm. Osborne Bartley and Ingmar Wickbom. Acta radiol. **53**: 33–41, January 1960. (Roentgen Departments I and II, Sahlgrenska Sjukhuset, Gothenburg, Sweden)

Rupture of the diaphragm usually follows nonpenetrating trauma to the abdomen, being the result of a transmitted pressure wave. Street accidents and falls are the commonest causes. The condition is easily overlooked because of other more obvious injuries. Since 95 per cent of cases occur on the left side, the stomach, splenic flexure, and spleen are most frequently forced into the thorax, and to the herniation of these organs the signs are usually attributable. Increase in the intrathoracic pressure may produce dyspnea and shock, and compression of the abdominal viscera may give rise to digestive tract disturbances. Symptoms may appear immediately but sometimes are delayed for years.

The diagnosis is best established by roentgen examination of the chest. In typical cases, the stomach or

colon will be evident in the thorax. The herniated, distended viscus may mimic a high diaphragm, but with change in posture there will be a conspicuous alteration in the shape and position of the dome-like formation. If the lateral part of the dome is the highest point, with the patient recumbent, a diagnosis of lateral rupture can be made. Less commonly, the herniated organs are obscured by or filled with fluid. A barium meal or enema may be required in doubtful cases, but the most reliable diagnostic procedure is pneumoperitoneum. The latter will localize the diaphragm and will result in pneumothorax if a rupture is present. Rupture of the right cupola is more difficult to diagnose but is less alarming, since the liver plugs the opening. Local prolapse of the liver may produce a rounded opacity immediately above the diaphragm.

Nine cases are reported, 8 on the left side and 1 on the right.

Nine roentgenograms.

EUGENE A. CORNELIUS, M.D.
Houston, Texas

THE MUSCULOSKELETAL SYSTEM

Radiological Bone Changes in Cushing's Syndrome and Steroid Therapy. R. O. Murray. Brit. J. Radiol. **33:** 1–19, January 1960. (Institute of Orthopaedics, London, England)

Cushing's syndrome, consisting of obesity, hypertension, weakness, and depression of sexual function, is attributable to overproduction of the adrenocortical steroids, particularly cortisone and hydrocortisone. The cause of this overproduction is hyperplasia or neoplasia of the adrenal cortex.

The major radiological changes include widespread osteoporosis, pathological fractures, abnormal callus formation, and delay in skeletal development. The osteoporosis is more easily seen in the axial skeleton than in the extremities. Pathological fractures most frequently involve the spine, ribs, and pelvis. The abnormal callus formation, having a "cottonwool" appearance, represents an incomplete attempt at fracture healing associated with inhibition of osteoblastic function by the excess hormones. The fractures are often painless and death is commonly due to infection.

Manifestations of iatrogenic disease of the skeleton following the therapeutic administration of steroids consist of (1) Cushing's syndrome, (2) osteoporosis, fractures, and joint degenerations without fully developed Cushing's syndrome, (3) bone and joint infections, and (4) delay in skeletal development in children.

When Cushing's syndrome develops as a result of steroid therapy, it is indistinguishable radiologically from the natural form of the disease. It is likely to occur when cortisone or cortisone-equivalent dosage of 50 to 100 mg. daily is maintained for from six months to three years.

Osteoporosis, fractures, and joint degenerations without the full Cushing's syndrome may occur after much shorter periods of steroid therapy. The fractures show pseudocallus formation. Pain tends to be suppressed or absent except in vertebral compression fractures, where girdle pain occurs, possibly due to secondary nerve root compression.

Joint degenerations which may resemble those seen in Charcot neuropathy are attributed to the improved sense of well-being with resultant increased motion and trauma in the absence of the warning sense of pain. Bone and joint infections also develop more easily and spread more rapidly and silently in the absence of normal pain sense and suppression of the normal reaction of the body to inflammation. Intra-articular steroid injection adds the hazard of introduced infection.

These complications are not frequent and do not indicate a need to discontinue therapy, since many of them can be overcome by use of protective hormones and antibiotics.

Thirty-three roentgenograms.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Haemophilia and Christmas Disease. J. H. Middlemiss. Clin. Radiol. (J. Fac. Radiologists) **11:** 40-50, January 1960. (United Bristol Hospitals, Bristol, England)

The author discusses hemophilia and Christmas disease [a hemorrhagic disease due to a deficiency of the thromboplastic component of the plasma]. The etiology and genetics, as well as the main clinical features, are described. Both hemophilia and Christmas disease show similar roentgen manifestations. Differentiation between the two diseases is by laboratory procedures, and, as far as practical management and prognosis are concerned, is not of great significance.

The radiologic signs can be attributed to hemorrhage, the appearances depending upon the site of the bleeding, on its chronicity, and on the age of the patient. Hematoma of the soft tissue rarely gives radiologic signs, but there may be secondary manifestations, such as scoliosis, secondary to retroperitoneal hematoma, displacement of the bowel shadows from the swelling, and obliteration of the normal retroperitoneal landmarks. Intussusception is not a common event in children afflicted with this condition but may occur.

In the bony skeleton, the features which may be demonstrable are due to (*a*) intra-articular hemorrhage, (*b*) intra-osseous hemorrhage, or (*c*) subperiosteal hemorrhage.

The changes due to intra-articular hemorrhage are most commonly seen in the knees. An initial solitary hemarthrosis is similar to any synovial effusion. Hemosiderin deposits may occur in the organizing intra-articular blood clot, and this may cast a denser shadow with a granular appearance. The hemosiderin may in time be reabsorbed or may consolidate and calcify to form "joint mice." An organizing blood clot may lead to the development of secondary osteoarthritis. The cartilage becomes damaged and pitted, and its surface irregular, and the joint space is narrowed. Changes in subchondral bone, sclerosis and "cyst" formation as commonly seen in osteoarthritis, also occur. In children, the hyperemia may produce marked osteoporosis, accelerated growth of the epiphyses, and advanced maturation of the epiphyseal cartilage.

Intra-osseous hemorrhage may disrupt the local blood supply to the part to such an extent that ischemia occurs and an infarction follows. This infarct or aseptic necrosis in bone behaves like that due to any other cause.

Subperiosteal hemorrhage is the most uncommon cause of hematoma formation in these diseases. Periosteal reaction along the shaft near an infected joint will occasionally be seen. This is merely a manifestation of reactive hyperemia. However, larger subperiosteal hematomas may occur and calcification will be seen. Rarely, a tension subperiosteal hematoma may arise

with repeated hemorrhage into the organizing encapsulated hematoma. Pressure atrophy of the cortex and subsequently of the underlying medulla then takes place, and a condition is seen in which the bone is apparently being destroyed and new bone is being laid down within the tumor—the so-called pseudosarcoma or pseudotumor of hemophilia. The condition may be progressive over many years. Sometimes it remains unchanged for long periods and then, following further bleeding, again undergoes expansion. The lesion may have a bony outer edge expanding beyond the original line of the bony skeleton, and the margins within the bone may be well defined with a sclerotic edge, or may be ill-defined. There is usually a large associated soft-tissue swelling, which is firm and painless. This type of hematoma is always under considerable pressure. Biopsy should be avoided, as it is often followed by continuous bleeding.

Special features are multiple transverse lines in the growing skeleton. In adults, knee joints that have been the sites of multiple hemarthroses may show a widened and deepened intercondylar notch, probably due to repeated hemorrhage into the attachment of the cruciate ligaments.

If there have been repeated hemorrhages into a joint and its adjacent bone, great demands are made on the local blood supply. The nutrient artery to the bone may then become dilated and its canal enlarged.

Twenty-two roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Non-Osteogenic Fibroma of Bone. W. M. Purcel and F. Mulcahy. Clin. Radiol. (J. Fac. Radiologists) 11: 51–59, January 1960. (Middlesex Hospital, London, England)

The authors review the subject of non-osteogenic fibroma of the bone. This is a benign cyst-like condition generally found in the metaphysis of a long bone in older children and young adults. Histologically, the tumor is shown to contain whorls of connective tissue interspersed with giant cells and frequently also lipoid-containing macrophages. Many of the patients are sent with pain or swelling in the neighborhood of a large joint, often with a history of minor trauma. A small number will have a pathological fracture through the lesion. In the remainder the discovery will be made during x-ray examination for unrelated conditions. Sites commonly involved, in order of frequency, are the lower end of the femur, the upper end of the tibia, the lower end of the tibia, and either end of the fibula; less frequently, the radius, ulna, humerus, and ribs.

Radiologically, in the long bones the lesion is always found in the upper or lower third of the shaft in the region of the metaphysis. When the tumor is first discovered, there is an intervening area of normal bone between it and the epiphyseal cartilage. The radiologic appearances tend to fall into two main groups. First, there is a small circular or oval translucent defect with a sclerotic inner margin eccentrically placed in the region of the metaphysis. It may be up to 1.0 cm. in length, and is often dismissed as a simple bone cyst. From the reported cases, it would appear that lesions of this group may either disappear spontaneously or enlarge and assume the characteristics of the second type. [Presumably, this represents the lesion known in America as benign cortical defect.—T. E. K.]

The appearance of the lesions in the second group depends largely upon the width of the shaft of the bone involved. Those occurring in the wide tubular bones present some or all of the following radiological features. An eccentrically placed zone of translucency is observed in the metaphysis which constantly shows a thin sclerotic shell of bone on its medullary aspect. The lesion has a cystic appearance, its walls frequently having a scalloped outline. The presence of irregular bony trabeculae often gives the impression of loculation. The long axis of the lesion corresponds with that of the bone. Usually the outer margin is joined to the cortex, which it may thin and expand, and large lesions frequently result in imperfect tubulation. In other cases, cortical thickening may be produced.

When the narrow tubular bones such as the fibula, radius, or ulna are involved, the lesion frequently occupies the entire width of the shaft and may expand the whole circumference of the bone. This type of lesion has often been misdiagnosed as a bone cyst or as an area of monostotic fibrous dysplasia.

In the ribs or pelvis, there is a cystic or multicystic translucency with a typical sclerotic margin and thinning or expansion of the overlying cortex. There will probably always be some doubt about the diagnosis of the pelvic lesions.

The authors present a summary of the chief findings in 17 cases.

The differential diagnosis includes osteoclastoma, enchondroma, xanthomatosis, occasionally osteoid osteoma, monostotic fibrous dysplasia, and unicameral bone cyst.

Seventeen roentgenograms; 2 photomicrographs; 1 diagram; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Chordoma. B. W. Windeyer. Proc. Roy. Soc. Med. **52:** 1088–1100, December 1959. (Middlesex Hospital, London, England)

Chordoma is a tumor arising from the remnants of the notochord, which in the embryo extends from the pheno-occipital junction to the coccyx. With the development of the vertebral column the notochord becomes divided into segments and disappears as an entity. Occasional vestigial remnants have been observed within the vertebral bodies. It normally persists as the nucleus pulposus of the intervertebral disk.

Chordomas may develop at any point from the upper to the lower extremity of the vertebral column but are most numerous in the sacrococcygeal and basisphenoid areas. They are typically slowly growing and locally invasive, but distant metastases, though rare, have been reported. The tumors may attain a very large size. Clinical features will depend upon location of the growth.

The author presents observations on 29 cases of chordoma: 8 in the spheno-occipital area, 13 in the sacrococcygeal region, and 8 elsewhere in the vertebral column. Radiographically, the tumor will cause irregular destruction of the affected bone, bursting through the cortex and forming a soft-tissue mass extending outward. Arteriography will show displacement of adjacent vessels but no new blood supply in the tumor. Calcification will be found in these growths, but no new bone, as this is not an osseous neoplasm.

Curative surgery is difficult as complete ablation is seldom possible due to the location of these tumors. The author has employed radiotherapy, both conventional deep therapy and supervoltage. Excellent pal-

liation may be obtained. In one case an 18-year remission followed irradiation, although histological proof of the nature of the tumor was lacking. Of 8 patients who have received supervoltage therapy since 1954 for sacrococcygeal chordoma, 6 were without symptoms or signs of disease at the time of this report; 1 has a probable recurrence after two years of freedom, and 1 is too recent for evaluation.

Nineteen cases are reported.

Nine roentgenograms; 3 photomicrographs; 2 photographs; 1 diagram; 2 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Radiological Lesions in Gout. S. de Sèze, A. Ryckewaert, J. Levernieux, and R. Marteau. J. de radiol. **41:** 1–13, January-February 1960. (In French) (Paris, France)

The authors have sought to define the radiologic changes in gout, to determine their frequency, and to evaluate their diagnostic significance. Their review is based on the study of 50 cases of nontophaceous gout and 50 cases of tophaceous gout.

Generally speaking, the diagnostic value of the roentgenologic appearances in gout is slight. Small defects cannot constitute a definite argument for the diagnosis of gout because identical defects are frequent in chronic rheumatic arthropathies, particularly in chronic rheumatic polyarthritis. Only the large defects (greater than 5 mm.) are actually indicative of gout, but are not pathognomonic; they may be encountered in chronic rheumatic polyarthritis and, moreover, they are usually to be seen in tophaceous gout, in which the diagnosis is generally evident.

Apart from the large defects, the roentgenologic peculiarities of gout include elective involvement of the metatarso-phalangeal and interphalangeal joints of the great toe and of the metatarso-phalangeal joint of the fifth toe, the random dissemination and irregular severity of the lesions of the hands, and the usual absence of decalcification in the feet and the hands except during acute attacks.

The authors point out that the significant roentgenologic defects are confined to the feet and the hands. Defects in the other joints are in general difficult to explain. Among these prepatellar osteophytosis and beaking of the olecranon deserve some attention.

In the authors' experience there is little chance of demonstrating important roentgenologic defects in joints that have never been affected by acute gout.

Twenty-nine roentgenograms; 4 tables.

RENÉ HOURI, M.D.
New York, N. Y.

Seasonal Distribution of Initial Appearance of Postnatal Ossification Centers in Hand and Wrist of Undernourished Children. Samuel Dreizen, Richard M. Snodgrasse, Jo G. Dreizen, and Tom D. Spies. J. Pediat. **55:** 738–743, December 1959. (S. D., Northwestern University Medical School, Chicago 11, Ill.)

The time of appearance of 31 postnatal ossification centers in roentgenograms of the hand and wrist was determined in 282 undernourished children. The roentgenograms had been taken every three months until the child was five years of age and every six months thereafter. Each child had clinical and laboratory evidence of chronic nutritive and growth failure based on previously recorded diagnostic criteria (Mann, Dreizen, and Spies. J. Pediat. **31:** 161, 1947). The series included 157 boys and 125 girls, ranging in age from three months to thirteen years, six months.

Analysis of the results revealed a seasonal pattern which is not related directly to sex, type of center, or month of birth. The number of centers initially appearing in the summer (31 per cent) was greater to a statistically significant degree than that emerging in any other season. The temporal coincidence of a peak in occurrence of new ossification centers and a diminution in rate of general body growth may be related to a seasonal variation in the availability and utilization of specific nutrients and accessory food factors.

Two figures; 1 table.

Diagnostic Considerations in Fractures of the Carpal Scaphoid Bone. I. Kessler, Z. Silberman, J. Heller, and L. Pupko. Surg., Gynec. & Obst. **110:** 117–120, January 1960. (Central Clinic Zamenhoff, Tel Aviv, Israel)

The difficulty in establishing a diagnosis of fracture of the carpal scaphoid or in evaluating the degree of bony healing of the fracture fragments is emphasized by the authors. The frequent occurrence of nonunion in these fractures and the long period of immobilization necessary for their healing makes accurate diagnosis most important.

Many fractures of the carpal scaphoid can be missed when the fracture line is diagonal rather than parallel to the x-ray beam. In an effort to reduce the incidence of diagnostic error in these lesions, the authors advocate multiple, slightly varied projections, in addition to routine examination of the wrists, in any case in which clinical suspicion of a navicular lesion or a roentgenologic change in the bony structure, however slight, is demonstrated.

Four cases are presented in which nonunion of carpal scaphoid fractures was discovered by angled "searching" projections following inconclusive routine studies of the wrists and carpal scaphoid.

Twenty-one roentgenograms; 3 line drawings.

ROBERT E. JACOBS, M.D.
University of Pennsylvania

Acute Suppurative Arthritis of the Hip in the Neonatal Period. Benjamin E. Obletz. J. Bone & Joint Surg. **42-A:** 23–30, January 1960. (Children's Hospital, Buffalo, N. Y.)

Fifteen cases of suppurative arthritis of the hip joints in the neonatal period are presented, 6 in premature and 9 in full-term infants. The seriousness of the disease and the importance of the early diagnosis and treatment are discussed.

Involvement of the hip joint must be suspected in an infant with clinical manifestations of septicemia, and, in addition, one or more of the following: pain reaction, elicited by palpation of the hip or by passive movement of the extremity; unilateral edema or swelling of an extremity, buttock or genitalia; lack of active movement of the lower extremity; asymmetrical thigh and buttock creases; abnormal position of the femur in flexion and adduction, with a bulge over the buttock.

Roentgenograms of the hips are of great value in establishing the diagnosis and in following the course of the disease. In several instances, roentgenographic findings pointed to the diagnosis before septicemia or hip-joint infection was suspected on clinical grounds. These early findings included soft-tissue swelling and

capsular distention and some degree of lateral and upward displacement of the femur.

In the absence of an ossified femoral head at this age, it is not possible to determine the location or integrity of the head by roentgenograms. Some degree of lateral and upward dislocation of the femur on the pelvis, indicating subluxation or dislocation, was seen on the roentgenograms of every one of the 16 hips in the group of infants in this study.

A focus of bone destruction indicating osteomyelitis may be seen early. This was noted in 4 patients; roentgenograms made on the day that suppuration was suspected indicated that the primary focus of bone infection preceded the liberation of pus into the joint. Subsequently, more definite evidence of osteomyelitis was demonstrable, first in the destructive phase and later in the reparative stage.

Later roentgenograms showed the final relationship of the femur to the pelvis, the fate of the femoral head, and the effects of the infection on the upper end of the femur.

It is concluded that the most important factors in saving the cartilaginous femoral heads in infected hip joints in the neonatal period are early diagnosis and prompt evacuation of pus, preferably by surgical incision and drainage. Systemic antibiotics proved to be effective only in controlling septicemia and osteomyelitis, but failed to sterilize the infected hip joints.

Six roentgenograms; 1 photograph; 3 tables.

RAUF YAGAN, M.D.
Cleveland Metropolitan General Hospital

Transient Synovitis of the Hip Joint in Children. Alexander Spock. Pediatrics **24**: 1042–1049, December 1959. (U. S. Army Dispensary, Fort Richardson, Alaska)

The author reports an analysis of 47 cases of transient synovitis of the hip in 46 patients (30 males, 16 females) under fourteen years of age, with special attention to the etiology, clinical manifestations, roentgen findings, treatment, and the relationship to Legg-Perthes disease. Symptoms appeared suddenly in 38 of the children, and three-fourths sought medical care within four days. The right hip was involved in 26 cases. Forty-five patients had pain in the hip or a limp. Restriction of passive motion of the hip joint was noted in all patients; limitation in abduction occurred in 44, in internal rotation in 43, in external rotation in 39, and in extension in 37. The presence of an acute streptococcal infection in 4 patients and a Coxsackie B virus infection in another suggests that these agents may be among those etiologically responsible for the transient synovitis syndrome.

Roentgen evidence of soft-tissue abnormalities about the involved hip has been reported in 60 to 90 per cent of patients with transient synovitis. In the present series abnormal soft-tissue shadows were suspected in 7 patients, but the appearance was not specific. Two points are emphasized: first, the soft-tissue changes vary with the quality of the roentgenogram and, second, the appearance of these abnormalities can be altered by a slight shift in the position of the involved extremity. Roentgenography is useful, therefore, only in excluding other pathologic conditions and is not helpful in the diagnosis of transient synovitis. No patients in the present series exhibited bony abnormalities.

Bed rest with prevention of weight bearing until the patient is completely asymptomatic is the best form of treatment, and failure to follow such a régime results in prolongation of the disability. Antibiotics do not appear to influence the course.

In 3 of the 46 patients Legg-Perthes disease developed—in 2, seventeen months following the initial episode of synovitis and in the third after an asymptomatic interval of three months. A review of the case histories and roentgenograms failed to disclose any differential factors by which the occurrence of Legg-Perthes disease could have been anticipated.

Seven tables

Coxa Plana in Monozygotic Male Twins. Adolphus W. Dunn. J. Bone & Joint Surg. **42-A**: 178–183, January 1960. (U. S. Naval Hospital, Guam, Mariana Islands)

Coxa plana in twins is rarely encountered. Only 2 examples were found in the literature, though several writers have mentioned the familial aspects of this entity.

The author reports a case of simultaneous occurrence of coxa plana in monozygotic male twins of five and a half years. One of the twins gave a history of some limitation of internal rotation and abduction of the right hip and a slight left-sided limp; the other was asymptomatic. In both patients roentgen examination revealed coxa plana. Both were treated with a patten-bottom brace, later replaced by an ischial weight-bearing brace with functional knee hinge. Roentgenograms taken at the end of treatment showed healing in each instance.

The roentgenologic examination of two older siblings disclosed no abnormality.

Eight roentgenograms.

RAUF YAGAN, M.D.
Cleveland Metropolitan General Hospital

Late Appearance and Evolution of a Cortical Defect in a Boy with Delayed Puberty. Gerhart S. Schwarz. J. Bone & Joint Surg. **42-A**: 173–176, January 1960. (College of Physicians and Surgeons, Columbia University, New York, N. Y.)

The term cortical defect is purely descriptive, referring to transitory cyst-like rarefactions in the cortices of tubular bones, formerly discussed under such designations as solitary xanthoma, cartilage rests, non-osteogenic fibroma, localized fibrous lesion, and subperiosteal desmoid tumor. The condition is seen more often between the ages of four and twelve. It has been said never to have been observed for the first time after the fourteenth year. The author, however, reports a case of delayed puberty in which a cortical defect was discovered at the age of eighteen on roentgenograms obtained because of an osteoid osteoma of the same bone. By the age of twenty-three the defect had become bicameral and was surrounded by a definite sclerotic zone.

Although this patient's chronological age was about eighteen years when the cortical defect appeared, his skeletal age according to roentgenograms was only fourteen to fifteen years, coinciding with the latest age at which the defects have been reported in the literature. The histological testicular age was only twelve to thirteen years.

The author suggests the possible implication of an endocrine mechanism as a causative or contributing factor in the formation of these lesions.

Five roentgenograms.

RAUF YAGAN, M.D.
Cleveland Metropolitan General Hospital

GYNECOLOGY AND OBSTETRICS

Problems in Hysterosalpingography. Maurice R. Dufresne, Leon Gérin-Lajoie, and Roger Maltais. J.A.M.A. **170:** 1169–1171, July 4, 1959. (1560 Sherbrooke St. E., Montreal, P. Q., Canada)

The authors correlate clinical data with the roentgenographic and pathological findings in a series of 935 hysterosalpingograms (1952–57). Fifty-two per cent of the patients were operated upon.

The diagnostic accuracy of hysterosalpingography is stated to be high in detecting anomalies (100 per cent). Carcinoma of the corpus uteri usually presents suggestive signs. Less accuracy is attained in recognizing endocervical polyps (65 per cent), fibromyomas (58 per cent), cavitary polyps (75 per cent), ovarian cysts (70 per cent), and ectopic pregnancies (50 per cent). The procedure is unreliable in disclosing endocervicitis (10 per cent), endometrial hyperplasia, and endometritis. Certain morphologic types of tubal lesions are readily recognized, but the detection rate in tuberculous salpingitis is considered to be low.

Five diagrams. P. F. CHRISTENSON, M.D.
Fontana, Calif.

Clinical Evaluation of Pelvicephalography: Review of 1,200 Cases. Edward L. King, Isadore Dyer, John A. King, and Milton J. Hoffman. J.A.M.A. **170:** 1165–1169, July 4, 1959. (1521 Delachaise St., New Orleans, La.)

Careful pelvic examination in the last six weeks of pregnancy provides fairly reliable information regarding the feasibility of safe vaginal delivery, though accurate recording of measurements requires radiographic mensuration.

For twenty-five years, the authors have used radiographic studies in evaluation of selected obstetric cases. Because of dangers to the fetus from radiation, however, more reliance has been placed in later years on the clinical evaluation of the maternal pelvis. During 1946–47, 272 of 702 patients underwent antenatal pelvimetry; whereas in 1956–57, only 44 of 597 were subjected to that procedure.

Reviewing 1,200 cases, with comparison of radiologic and clinical findings as to normality of the pelvis, the authors found agreement in 724 cases, clinical error in respect to the midplane in 164 (110 on the conservative side), and insufficient data for comparison in 312. In 1946–47, 38.7 per cent of patients were studied radiographically and the section rate was 10.1 per cent. For the years 1956–57, however, only 7.38 per cent were so studied and the section rate was 7.2 per cent.

Radiographic pelvimetry is considered to be of great aid in doubtful cases, but clinical studies alone will suffice in 70 to 80 per cent of the patients. The method should not be withheld when indicated, but is not recommended routinely because of possible genetic effects on the fetus. P. F. CHRISTENSON, M.D.
Fontana, Calif.

THE GENITOURINARY SYSTEM

Excretory Urography in Infants and Children. Improved Results Through the Use of Postero-Oblique Projections. Alfred Jungmann. J. Pediat. **55:** 752–757, December 1959. (6 Arlosorow St., Haifa, Israel)

Because of the accumulation of gas in the intestines, it is difficult to obtain satisfactory excretory urograms in children. Results may be improved by either elimination or "evasion" of the gas. The latter has more often proved helpful. It may be accomplished by mechanical procedures or by an improvement in the roentgen technic.

Mechanical Procedures: The object of mechanical procedures is to displace the gas-filled intestinal loops by the distended stomach. This is achieved by filling the stomach with fluid or with gas and fluid. The fact that liquids have to be withheld for twelve hours before the examination imposes a limitation on the procedure in children in poor general condition or those who live in an extremely hot, dry climate.

Improvement in Roentgen Technic: Tomography permits satisfactory investigation of the kidneys and urinary tract in infants by way of descending urography, but the necessary equipment is not available in all hospitals. The author has introduced a method of investigation which does not require elaborate preparation of the patient or a complicated technic. Because of the retroperitoneal location of the kidneys, intestinal gas does not obstruct the pyelographic picture in the lateral projection. Since in a true lateral view the renal shadows are almost superimposed on each other, children are positioned at an angle of approximately 75° in the right or left posterior oblique diameter. Thereby, the kidney closest to the film is projected upon the anterior part or even slightly in front of the vertebral bodies, while the kidney on the far side is projected upon the posterior part of the vertebral bodies or into the small arch formed by the posterior parts of the lower ribs. Owing to the obliquity, a loop or two of gas-filled intestine may sometimes be interposed, but in the author's experience, this has not caused serious interference with a clear view of the kidneys. It is certainly not possible to see in a lateral or oblique view of the kidney the same details which are visible in an anteroposterior view, when it is free from gas. By the method described, however, it is possible regularly to determine whether or not there is excretion, whether the kidney is displaced or in normal position, and whether there is gross distortion of the kidney cavities. In other words, in excretory urography of infants and children, the postero-oblique view is a reliable help in cases of suspected anomalies, tumors, cysts, hydronephrosis, thrombosis of renal vessels, or displacement of the kidney.

Eight roentgenograms; 1 photograph; 1 drawing.

Nephrotomography in the Differentiation of Renal Cyst from Neoplasm: A Review of 500 Cases. Kuo York Chynn and John A. Evans. J. Urol. **83:** 21–24, January 1960. (New York Hospital-Cornell Medical Center, New York, N. Y.)

The authors discuss the usefulness of nephrotomography, especially in differentiating renal cysts from renal tumors. In a series of 500 cases, their diagnostic accuracy for renal cyst was 95 per cent and for renal tumor 94 per cent. A major factor in misdiagnosis is poor film quality.

The technic employed includes: (1) a preliminary film of the abdomen; (2) test tomograms to ascertain the proper level for best demonstration of the kidneys; (3) the insertion of a Robb-Steinberg needle (size 12) into an antecubital vein; (4) determination of circulation time with 2.5 c.c. of 20 per cent Decholin mixed with 15 c.c. of saline; (5) injection of 30 c.c. of 50 per cent Hypaque to intensify the nephrogram effect; (6) rapid

injection of 50 c.c. of 90 per cent lukewarm Hypaque. Following this, one conventional film of the abdomen is taken at the predetermined circulation time in order to demonstrate the abdominal aorta and renal arteries. This is immediately followed by 4 to 6 tomograms. The renal arteries and their branches were demonstrated in 75 per cent of the authors' cases.

No fatalities or severe side-effects occurred in this series. The incidence of vomiting and urticaria was 5 per cent or less.

A table summarizing the factors in differential diagnosis of renal cyst from renal tumor is provided.

Ten roentgenograms.

EUGENE F. FOLEY, JR., M.D.
University of Pennsylvania

Application of X-Ray Cinematography in Urology: I. Mechanism of Ejaculation. Hideo Mitsuya, Jun Asai, Keiji Suyama, Takao Ushida, and Kenzō Hosoe. J. Urol. **83:** 86–92, January 1960. (Nagoya University School of Medicine, Nagoya, Japan)

This article represents one of many publications from the Nagoya University School of Medicine (Nagoya, Japan) concerned with the investigation of the secretory function of the male sexual organs and the accessory organs of reproduction.

The discharge of semen was studied with the cinefluorographic method. A Philips image intensifier, Shimazu x-ray tube with a rotating anode, Shimazu x-ray apparatus (1000 ma), and Bolex-H 16-mm. camera (Switer F 1.4 lens) were used.

Contrast medium was injected into the spermatic cord previously exposed and separated. The separated vas was punctured with a 1/1 needle and was inserted carefully into the vasal lumen. Less than 2.5 c.c. of 40 per cent "Moljodol" was injected into the vas with a special screw-type syringe of 2 c.c. capacity. After micturition the patients were placed in a supine position facing the image intensifier. The exposure factors were: 60 kv, 1.5 ma, camera speed 8–32 frames per second. The patients were told to call out when they were about to ejaculate by masturbation. Motion pictures were usually taken from the time of injection of contrast medium until the end of ejaculation.

Examinations were performed on 16 healthy males without symptoms of inflammation of the sexual organs.

The discharge of semen consists of a movement that drives off secretions from the epididymis, ampulla, seminal vesicles, prostate and para-urethral glands by unconscious, vigorous and rhythmic contractions. Such movements are due to the co-ordination of the sexual organs of reproduction, perinei muscles, and penis. With cinefluorography, the pre-ejaculatory, ejaculatory, and terminal ejaculatory stages were clearly demonstrated. The ejaculatory stage was shown to consist of two phases, namely, propulsion of semen from the accessory organs of reproduction into the posterior urethra and then from the posterior urethra into the external orifice of the urethra.

Cinefluorography, in the authors' opinion, is the best method for analysis and recording of the ejaculatory process.

Four cinematograms.

ROMAN MARCINIAK, M.D.
University of Pennsylvania

Acute Renal Failure Following Intravenous Pyelography in Multiple Myeloma. W. Scheitlin, G. Martz, and U. Brunner. Schweiz. med. Wchnschr. **90:** 84–87, Jan. 23, 1960. (In German) (Medizinische Universitätsklinik Zürich, Switzerland)

The authors report a case of acute renal failure in a female with multiple myeloma. Symptoms of oliguria developed twenty-four hours following intravenous injection of Triopac. Death from uremia ensued nineteen days later. Autopsy showed changes in the kidneys compatible with myeloma and pyelonephritis. These findings did not explain the acute oliguria. A number of similar cases have been reported in the literature.

The mechanism of the acute renal failure in multiple myeloma following pyelography is not explained. It may be that the intravenous injection of the contrast material causes the acute renal failure by stimulating progression of the irreversible changes in the "myeloma kidneys."

Two photomicrographs; 1 chart; 1 table.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Spontaneous Rupture of Intrarenal Arteriovenous Fistula: Report of a Case. Kendall E. Sauter and James W. Sargent. J. Urol. **83:** 17–20, January 1960. (324 E. Wisconsin Ave., Milwaukee 2, Wisc.)

The authors present what they believe to be the eighth reported case of a spontaneous intrarenal arteriovenous fistula. This was felt to have arisen from the rupture of an aneurysmal dilatation of one vessel through the wall of an adjacent vessel. The rupture of the aneurysm was associated with severe hemorrhage.

The patient, a 69-year-old man, stated that he had been in good health until approximately one year prior to the onset of his acute illness, when he first noticed vague intermittent discomfort in the left flank area. He was hospitalized following the abrupt onset of severe typical left renal colic. The blood pressure, at the time of admission, was found to be normal, but there was a tachycardia of 110 per minute with frequent extrasystoles. The patient was very obese, and it was impossible to confirm the presence of a mass in the left flank region, although there was some suggestion of tenderness in that area.

Laboratory studies demonstrated a slight reduction of hemoglobin, hematocrit, and red cell count. The white count was 10,700 per cubic millimeter. The urine sediment contained 4 or 5 red blood cells and an equal number of white cells per high-power field. A 4+ albuminuria was present.

Mild cardiac enlargement with left ventricular hypertrophy and a dilated and elongated aorta were demonstrated on roentgenograms of the chest. A roentgenogram of the abdomen was reported as showing a large left renal shadow over the upper portion of which was seen a thin, semicircular line of calcification. The left psoas shadow was obliterated. The right kidney was found to be normal by excretory urography, but no function was demonstrated on the left. Retrograde urograms showed lateral displacement of the left kidney, particularly at its upper pole. The calyceal pattern was abnormal, but not diagnostic. Translumbar aortography revealed the presence of contrast medium in an abnormal vascular pattern on the left that was intimately associated with the arterial system.

At surgical exploration Gerota's fascia was found to be distended with blood, and a thrill could be palpated

through this mass. The renal pedicle was ligated without opening Gerota's fascia, and the entire mass was removed. The surgical specimen revealed clotted blood in the perirenal space; in addition, the capsule had been stripped from the kidney and the subcapsular space was filled with approximately 700 c.c. of clotted blood. In the upper pole of the left kidney was a mass measuring 8 cm. in diameter, which contained a cystic cavity lined by an irregular mesothelium. In its walls calcified and sclerotic plaques were present. This cystic cavity apparently represented the venous aneurysm; because of the small size of the arterial elements, it was not possible to find the exact arterial entrance to the venous aneurysm.

It was apparent, following surgery, that the sudden onset of flank pain, tachycardia, and reduced red cell elements were secondary manifestations of acute hemorrhage following the rupture of the aneurysm. This complication of intrarenal fistula is uncommon and practically never occurs in peripheral arteriovenous fistula. The authors feel that the complication of rupture is a distinctive feature of this case, and, on the basis of present knowledge, it was the arterial elements which probably gave way, rather than the venous.

Aortography was felt to have been a distinct aid to diagnosis and treatment, and, though the exact site of an arteriovenous connection was not identified, significant information was made available to suggest the vascular nature of the problem.

Two roentgenograms; 2 photographs; 1 diagram.

H. W. SCOTT, M.D.
University of Pennsylvania

RADIOTHERAPY

Cancer of the Larynx: Indications for Treatment. LeRoy A. Schall. Am. J. Roentgenol. **83:** 6–9, January 1960. (Massachusetts Eye and Ear Infirmary, Boston, Mass.)

This paper is one presented in a symposium on problems in the management of cancer of the larynx (see following abstracts). The writer sticks close to his subject, "Indications for Treatment."

I. *Small localized tumors of the true cord without involvement of the anterior commissure or vocal process and with freely movable cord.* This type of lesion has ordinarily been considered ideal for thyrotomy for the following reasons: operation may be performed under local anesthesia; the mortality is less than 1 per cent; hospitalization averages a brief six days; regeneration of the vocal cord and development of fairly good voice may result if the vocal process of the cord does not have to be removed; the five-year survival rate should exceed 85 per cent in skilled hands. Impairment of the voice, however, may at times be serious. External irradiation will produce a comparable cure rate, with a chance for a better voice. The patient must, however, be kept under close supervision by both the radiotherapist and the laryngologist. Should the lesion fail to show satisfactory regression, surgical removal should be promptly undertaken irrespective of radiation reaction. Among the enumerated disadvantages of external radiation are: the long treatment period; the occurrence of epithelitis and epidermitis, which are occasionally severe; post-irradiation dryness of the throat; the hazard of delayed radiation reactions, including late infection and tissue necrosis. Irradiation failures subsequently seen by the author have been found no longer suitable for laryngofissure, so that total laryngectomy had to be performed. In recurrences following thyrotomy and subsequently treated by irradiation he has not yet obtained a single five-year cure.

II. *Tumors involving the entire length of one true cord with a movable cord and good airway* are not suitable for thyrotomy. Even though extensive thyrotomy may be successful in some cases, an equal number of failures will be recorded. This group is considered ideal for external irradiation.

III. *Lesions extending to the anterior commissure or crossing over to the other cord.* The author favors special operative technics for this group and does not discuss the feasibility of radiotherapy.

IV. *Tumors of the true cords that have infiltrated and caused fixation of the cord,* the author feels, should not be treated by external irradiation, being primarily surgical problems [presumably total laryngectomy.—J. W. B.] One important point is made: if the physician first consulted does not intend to do the laryngeal surgery, then he should omit biopsy until the surgeon who is to perform the definitive procedure has had an opportunity to evaluate the tumor and the larynx. Once biopsy has been taken, the traumatized larynx will present a degree of fixation and edema of the cord indistinguishable from malignant invasion.

V. *Localized malignant tumors of the rim of the epiglottis.* Surgical removal of the epiglottis is the writer's choice. He does not subscribe to the idea that "the higher the location of the lesion in the laryngeal box, the more susceptible it is to irradiation."

VI. *Tumors arising from the base of the epiglottis* are usually silent and are of relatively large size before diagnosis is made. Total laryngectomy is the treatment of choice.

VII. *Unilateral supraglottic lesions that may extend to the aryepiglottic fold, with or without palpable lymph nodes.* (*a*) Malignant involvement with palpable nodes is an indication for radical neck dissection combined with block resection of the larynx. (*b*) Unilateral supraglottic lesions without palpable nodes allow some divergence of opinion. The author favors wide-field laryngectomy without so-called prophylactic neck dissection. Since only about 10 per cent of patients with laryngeal carcinoma will have positive lymph nodes in the neck, it is not felt that prophylactic neck dissection is warranted.

Seven small diagrams.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Treatment of Cancer of the Larynx. Calvin T. Klopp and Stanley M. Kirson. Am. J. Roentgenol. **83:** 10–16, January 1960. (George Washington School of Medicine, Washington, D. C.)

Particularly stressed is the point that small laryngeal cancers can be readily controlled by presently available treatment methods, with minimal post-treatment disability. Early diagnosis is therefore of the first importance. The significant factors in the choice of treatment are the size of the primary tumor and, to a lesser extent, its location in the larynx. Carcinoma *in situ* is rarely diagnosed and is evidently a surgical

lesion. Early invasive cancer which has not infiltrated deeply nor produced immobilization or limitation of laryngeal structures may be successfully treated either by surgery or by radiotherapy, but the authors express a strong preference for surgical management. In their argument they cite the incidence (unstated here) of secondary necrosis and other late radiation sequelae. Also noted is the point that some tumors may be multicentric in origin with later manifestations of "new" tumors in irradiated tissue; complications of management may be encountered because of previous radiotherapy.

Invasive, deeply infiltrating tumors of the larynx likewise are surgical lesions. Whenever possible, partial rather than total laryngectomy must be chosen. Total removal of the larynx must be reserved for those cases of deeply infiltrating cancers which cannot be successfully handled by incomplete excision.

Metastatic laryngeal cancer in cervical lymph nodes is a surgical problem to be treated by neck dissection. Ordinarily such dissection is not done unless there is strong evidence of metastases.

The end results are presented in 12 small tables. One hundred sixteen cases reviewed by the writers are summarized. Approximately 50 per cent of all patients seen and treated survived five years.

The authors conclude that in their hands each case of carcinoma of the larynx is preferably treated by surgery unless very specific reasons to the contrary are present. They do not subdivide their cases according to stage of disease or site of origin, so that it is difficult to compare directly their results with other reports. On reviewing the data presented, two points stand out: (1) the unusually small number of cases selected for partial laryngectomy or laryngeal fissure (only 8 of a total of 116 treated cases); (2) the relatively poor results compared with those cited by others participating in this symposium (see preceding and two following abstracts).

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Radiation Therapy in Cancer of the Larynx. Simeon T. Cantril. Am. J. Roentgenol. **83:** 17–20, January 1960. (From the Tumor Institute of the Swedish Hospital, Seattle 4, Wash.)

The author expresses the opinion that the primary role of radiotherapy in laryngeal cancer should be the reduction, as far as possible, of the necessity for laryngectomy. Close collaboration between the laryngologist and the radiologist, with a recognition and acceptance of the limitations of each method of treatment, is necessary.

Drawing inferences and conclusions from data reported by others, the writer observes that "of all cases treated [at certain centers known for their interest in cancer of the larynx] more than two-thirds survived without laryngectomy when radiation was the principal method of treatment." In the largest recorded group of cases (Jackson *et al.*: J.A.M.A. **163:** 1567, 1957. Abst. in Radiology **70:** 452, 1958) two-thirds of the patients survived without necessity of total laryngectomy when partial laryngectomy or radiotherapy had been used in approximately comparable numbers of patients as a primary mode of treatment. It is noted that patients who would otherwise have required laryngectomy, because of the extent of their disease, have been able to avoid surgery in a very significant percentage of cases through the use of judicious radiotherapy, without jeopardizing survival. The author's contentions are supported by a series of concise tables presenting data drawn from reports of others and demonstrating the points under discussion.

The most common complications of carcinoma of the larynx which indicate inability of radiotherapy to cope successfully with the disease include the following: (1) invasion or necrosis of thyroid cartilage, (2) significant subglottic extension, and (3) immobility of the arytenoid process due to spread of cancer. Far advanced disease with invasion of an entire hemilarynx or high-grade cord fixation is in general not suitable for irradiation. Carcinoma of the epiglottis is frequently best managed by radiotherapy even when fairly extensive, provided the true cords or arytenoids are not involved. Extension of the disease to the pre-epiglottic space, into the valleculae or base of the tongue contraindicates surgery, so that radiotherapy must be relied on, but results are not favorable.

Contrary to opinions expressed by others, the writer feels that lymph nodes *associated with epiglottic cancer* can be controlled by irradiation in a majority of patients. Carefully administered radiotherapy through small fields for small carcinomas of the larynx will not seriously interfere with subsequent surgery should such be required because of failure to control the disease.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Indications for Radiation Therapy in Laryngeal Cancer. Robert Robbins. Am. J. Roentgenol. **83:** 21–24, January 1960. (Temple University Medical Center, Philadelphia, Penna.)

Cancer of the true vocal cords is staged according to Lederman's method and classified according to various anatomic sites of origin. Treatment technic, briefly described, is similar to that in general usage. Two hundred and forty-three cases in which the primary lesion was initially managed by radiotherapy and 64 cases in which treatment for recurrence followed other therapy comprise the material from which data and statistics are drawn. Pertinent observations are presented in thirteen succinct tables.

Important points include a five-year disease-free rate of 80 per cent for Stage I unilateral cord cancers and of 76 for bilateral Stage I cordal lesions, managed by external radiotherapy. Bilateral cases in Stage I (tumor confined to both cords, motion unimpaired) would otherwise have required total laryngectomy. Patients with this disease are long-term survivors. Eighty per cent of those living five years were free of disease at nine years also. Experiences with small numbers of patients with cancers arising in other anatomical sites, including subglottic tumors, false cord or ventricle lesions, epiglottic carcinomas, both with and without extension and node involvement, are summarized. The salvage rate in cases receiving radiotherapy for recurrent disease was poor, whether prior treatment had been by surgery or irradiation.

Utilizing data drawn from these cases, the author concludes that the following types of laryngeal cancer are amenable to radiotherapy:

(1) Cancer of the true cords, confined to one or especially both cords.

(2) Cancer arising in the false cord or ventricle.

(3) Cancer limited to the posterior surface of the epiglottis not extending lower than the vestibule or true cords.

(4) Cancer of the superior or lingual surface of the epiglottis with slight, or no, involvement of the valleculae.

When disease is more extensive than that described above, radical surgery is indicated. The author makes the point that medical contraindications to surgery should ordinarily be only those related to anesthesia, since vigorous radiotherapy as required in these cases is far more trying and debilitating than surgery, particularly in feeble individuals.

In the following groups radiotherapy has proved generally of so little benefit that they are best considered for palliation only: (1) recurrence following prior surgery or irradiation; (2) cancer of the true cord extending beyond the interior of the larynx; (3) advanced epiglottic tumors; (4) most cancers arising in the arytenoids, aryepiglottic folds, or laryngopharynx.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Effect on Survival of Certain Variables in Breast Cancer. Benjamin F. Byrd, Jr., John C. Burch, and Sam E. Stephenson, Jr. Ann. Surg. **149:** 807–812, June 1959. (Vanderbilt University School of Medicine, Nashville, Tenn.)

Some of the variables which may affect survival in breast cancer have been analyzed in a series of 1,162 consecutive cases of cancer of the breast. Only 5 patients in this group were lost to follow-up. With the conventional method of treatment, the authors obtained a five-year survival rate of 79.4 per cent in patients with no axillary node involvement and no x-ray therapy, and 40.1 per cent in those with axillary metastases and x-ray therapy. The ten-year survivals are reduced but in the same general proportions.

From the results, the authors conclude that there is no evident reason to abandon or change the role of surgery in the treatment of breast cancer. Of those variables which may be influenced by the surgeon it seems that technical ability and proficiency do play a role in survival. It would appear that while the poorest survivals are experienced in the period of life surrounding the menopause a healthy suspicion is the best tool in improving the survival rate. The average delay in seeking medical advice was 8.1 months in patients presenting with positive axillary nodes and 8.5 months in those without axillary metastases. If one is able to shorten by one-half the preoperative delay in the average patient, fewer involved nodes will be found in the laboratory, and those patients without node involvement and those with node involvement will have a better chance of five-year survival. In the authors' experience radiotherapy adds little in the absence of demonstrable nodes but contributes much when positive nodes are discovered in the excised axillary contents.

Finally, surgical ablation of the primary tumor can be accomplished in a very high percentage of patients with breast cancer and in most of these the addition of axillary dissection produces the most satisfactory therapeutic effect.

Five figures; 4 tables.

Cancer of the Lung in Women. Richard E. Ottoman and Justin J. Stein. California Med. **92:** 38–39, January 1960. (University of California Medical Center, Los Angeles 24, Calif.)

Among 283 patients with lung cancer seen at the School of Medicine, University of California at Los Angeles, between April 1955 and December 1958, 35 or about one-eighth were women. The signs and symptoms were similar to those in men, although the course seemed more rapid. Roentgen findings were not unusual except for the frequency of right-sided involvement.

Of the 35 women, 2 received only chemotherapy, 32 radiotherapy. Only 4 were alive at the time of report: 1 without evidence of disease at twenty months, 1 with symptoms of disease at eleven months, 2 under chemotherapy at two months. For 29 who received palliative or radical irradiation to the primary tumor site, the median survival time was twenty-six weeks.

Two tables.

SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Carcinoma of the Cervix Uteri: Treatment by Supervoltage Irradiation Only. A Preliminary Report. H. M. Mellor. Brit. J. Radiol. **33:** 20–27, January 1960. (Westminster Hospital, London, S. W. 1, England)

A method of treatment of carcinoma of the cervix by supervoltage therapy alone without use of intracavitary irradiation is presented in detail. The technic utilizes the Theratron Rotating Cobalt Unit employing two arcs and two centers of rotation. This results in simultaneous and homogeneous irradiation of the primary lesion and its areas of direct and lymphatic spread, with adequate doses and without local overdosage. Other advantages over radium therapy include reduction of radiation to the operator and staff and elimination of the need for anesthesia.

The treatment response in a series of 17 cases is described. Adequate radiation reaction in the cervix and vagina and good clinical regression of the primary lesion and parametrial extension were achieved in most cases. A remarkable absence of ill effects, constitutional disturbances, and rectal and bladder reactions was observed.

It is too early for evaluation of the end-results of this method of therapy but the early impressions are considered encouraging.

Eight figures, including 2 roentgenograms; 6 tables.

RICHARD P. STORRS, M.D.
Los Angeles, Calif.

Improvement of Therapeutic Results in Carcinoma of the Uterine Cervix in the Course of the Last Forty-three Years. Felix v. Mikulicz-Radecki. Strahlentherapie **111:** 1–7, January 1960. (In German) (Universitäts-Frauenklinik, Freie Universität Berlin, Germany)

The therapeutic results in carcinoma of the cervix have greatly improved during the past five decades, according to the author's personal experience. From 1910 until 1932 the cure rate doubled (from 15 per cent to 30 per cent). The rather sudden improvement in 1932 was due to routine practice of radical hysterectomy, reduction of surgical mortality, and more intensive high-voltage roentgen therapy. With further technical refinements, a five-year cure rate of 64.3 per cent could finally be effected in 1953. This result compared favorably with those of other institutions.

Surgical mortality has been reduced and early diagnosis is obtained more and more frequently, especially with the Papanicolaou stain technic.

Cancer clinics have popularized routine check-ups,

so that 67.5 per cent of all cases are now first seen in Stages I and II, against 50 per cent, formerly. Operability has increased from 34 per cent to 43.2 per cent, and postoperative roentgen therapy has been used more frequently in recent years, all of which contribute to the improved rate.

It is of special interest that in the 1953 series, with a cure rate of 64.3 per cent, 44 per cent of patients received only radiotherapy and that 46 per cent of Stage III and IV cases could be cured by combined radium and roentgen therapy. Supportive hormone therapy in selected cases also played a part in the favorable results.

It is believed that close co-operation between surgeons and radiotherapists is essential. Further improvement of statistical results, however, is mainly to be expected from more frequent recognition of the early stages of the disease.

Two charts; 1 table.

ERNEST KRAFT, M.D.
Northport, N. Y.

Therapeutic Results in Carcinoma of the Uterine Cervix and Corpus from 1948 Until 1953. Hermann M. Buchacker. Strahlentherapie **111:** 8–13, January 1960. (In German) (Universitäts-Frauenklinik Tübingen, Germany)

The author reports the results of treatment of uterine cancer, based on 770 cases of cervical carcinoma and 188 cases of corpus carcinoma, seen from 1948 to 1953.

Cancer of the cervix was treated exclusively by radiotherapy in 705 cases. Radical hysterectomy was performed in 59 cases, and was followed by postoperative irradiation in most instances. Preoperative radiotherapy was given in a single Stage I case. Five patients belonging originally to the radiotherapy group had to be operated on one to five months later because of radioresistance and/or progressive parametrial spread.

The absolute cure rate was 47.5 per cent as compared to 42.6 per cent for 385 cases treated in 1943–47. Factors favoring the improvement were better economic conditions, extensive use of supportive antibiotic drugs, and perhaps better radiotherapeutic technics. With improved anesthesia methods surgical mortality has been absent since 1951.

In cancer of the uterine corpus surgery was the method of choice in 124 cases (66 per cent). Radiation therapy was given preoperatively in 6 cases and postoperatively almost routinely. Far advanced and inoperable cases received irradiation exclusively. The relative cure rate for the operated cases was 76.6 per cent, but for the poor-risk radiotherapy cases it was only 35.9 per cent. The absolute cure rate could be increased from 54.6 per cent (1945–47) to 61.8 per cent. This improvement appeared to be mainly due to a higher percentage of early cases and the absence of surgical mortality.

Six tables.

ERNEST KRAFT, M.D.
Northport, N. Y.

A Code of Practice for X-Ray Measurements. Prepared by the Hospital Physicists' Association. Brit. J. Radiol. **33:** 55–59, January 1960.

The proposals included in the Code of Practice for X-ray Measurements prepared by the Hospital Physicists' Association of Great Britain cover a range of h.v.l.'s from 0.5 to 5.0 mm. Cu, with specifications for ionization chambers, phantom materials, and technics of measurement. Certain ambiguities are clarified. For example, back-scatter factors are to be applied to an exposure dose measured in the end plane of the applicator and, therefore, include scatter from the applicator.

Reprints of the Code may be obtained from Mr. C. Gregory, the Hon. Secretary of the Hospital Physicists' Association Diagrams and Data Scheme, Mount Vernon Hospital, Northwood, Middlesex, England.

LUCILLE DU SAULT
The Henry Ford Hospital

RADIOISOTOPES

Effect of Pretreatment with Methylthiouracil on Results of ^{131}I Therapy. James Crooks, W. Watson Buchanan, E. J. Wayne, and E. Macdonald. Brit. M. J. **1:** 151–154, Jan. 16, 1960. (Western Infirmary, Glasgow, Scotland)

A clinical experiment was undertaken to see whether pretreatment with methylthiouracil influenced the results of I^{131} therapy in thyrotoxicosis. One hundred and fifty patients were considered suitable for study. The doses of radioactive iodine were prescribed by the same physician and the observations on pretreated cases were controlled by those on untreated cases over the same time intervals. Four groups were investigated.

In *Group I* were 28 patients who had received methylthiouracil for periods ranging from three months to a year. Administration of the drug was discontinued one week before treatment with radioactive iodine. At this time all of the group were either euthyroid or minimally thyrotoxic.

Forty-five patients constituting *Group II* had been treated with I^{131} over the same period of time as those in Group I and had never received an antithyroid drug.

Group III consisted of 21 patients previously treated with methylthiouracil in the same way as those in Group I but in whom the dose estimated in the standard manner was arbitrarily increased by 25 per cent.

As the control to Group III, 56 patients (*Group IV*) were not pretreated. Their dose was determined in the same way as that of patients in Groups I and II. They differed from those in Group II only in the fact that they were treated contemporaneously with those in Group III.

The one-dose cure rate (28.6 per cent) in the 28 patients in Group I was significantly lower than that of the 45 patients in Group II (75.5 per cent). This difference could not be accounted for by differences in gland types or in the biological half-lives of the therapy doses of I^{131}. The one-dose cure rate in those in Group III (47.5 per cent) was not significantly different from that in the 56 patients in Group IV (59 per cent).

It is concluded that pretreatment with methylthiouracil until one week before administration of I^{131} renders the gland relatively radioresistant.

A simple clinical method of dose prescription was used in this study, and the results obtained in the 101 cases of Groups II and IV and observed for a minimum period of one year were as satisfactory as those reported by Blomfield *et al.* (Brit. M. J. **1:** 63, 1959. Abst. in Radiology **73:** 959, 1959), who aimed at de-

livering a predetermined amount of irradiation to the thyroid gland.

One graph; 2 tables.

Thyroid Function Measured by in Vitro Erythrocyte Uptake (Red-Cell Uptake) of I^{131}-Labeled *l*-Triiodothyronine. Results of 133 Determinations. O. Peter Schumacher and John W. King. Cleveland Clin. Quart. **27:** 28–34, January 1960. (Cleveland Clinic, Cleveland, Ohio)

Since it is now known that there are differences in the amount of thyroxin-binding protein in the blood, in the various grades of thyroid activity, the work of Hamolsky and others (see, for example, J. Clin. Endocrinol. **17:** 33, 1957; **19:** 103, 1959. Abst. in Radiology **69:** 790, 1957; **73:** 829, 1959) suggested the possibility of estimation of the amount of thyroxin-binding protein, and the study of thyroid function clinically, by the *in vitro* erythrocyte uptake of I^{131}-labeled *l*-triiodothyronine (hereinafter called RCU). The evidence to date indicates that this parameter of thyroid function is rarely affected by exogenous iodine medication.

The present report is a summary of the authors' experience with 133 RCU determinations in patients with various thyroid disorders. The average value in cases of myxedema was 11.1 per cent as against 17.8 per cent in euthyroidism and 29.5 per cent in hyperthyroidism (Graves' disease). Values for 12 (86 per cent) of 14 patients with myxedema were under 14.0 per cent; for 71 (90 per cent) of 79 euthyroid patients they were higher than 14.0 per cent; for 36 (90 per cent) of 40 patients with hyperthyroidism secondary to Graves' disease, higher than 22.5 per cent, and in 74 of 94 patients of the euthyroid group, less than 22.5 per cent. It is obvious that there is some overlapping of values in euthyroidism and in hyper- and hypothyroidism.

The measure of the clinical usefulness of the RCU, as with all thyroid-function tests, will depend on further understanding of those pathologic states, not related to the thyroid function, that affect the test. RCU has the advantage that no radioactive substance is administered to the patient, and it is relatively easy to perform in comparison with the test for protein-bound iodine.

One chart; 3 tables.

Therapeutic Principles in Management of Peptic Ulcer. 4. Radiation Therapy with Cobalt-60. Charles H. Brown. Am. J. Digest. Dis. **4:** 1066–1072, December 1959. (Frank E. Bunts Educational Institute, Cleveland, Ohio)

Cobalt-60 teletherapy was given to 72 patients with medically intractable ulcers (48 duodenal, 11 gastric, and 13 marginal ulcers) of long duration. Anterior and posterior fields centered over the upper two-thirds of the stomach were outlined by fluoroscopy with barium. A total depth dose of 2,000 r was given, in six to eight treatments through each port. Medical measures were continued. Side-effects were nausea in 10 patients and vomiting in 2. There were no skin changes. Follow-ups of over twelve months were obtained in 39 cases.

Treatment of peptic ulcer by radioactive cobalt is based upon the known depression of gastric acidity by radiation. In the present series, Histalog-stimulated acidity was significantly decreased in about 50 per cent of the patients six months after treatment, and in about 19 per cent after six to twenty-four months. Tests of fasting gastric acidity showed achlorhydria in 86 per cent two months after irradiation and in 49 per cent between twelve and twenty-four months.

All patients showed a good initial symptomatic response and healing of the ulcer, as shown radiologically, in two to three months. Sixty-four of the 72 patients remained continuously asymptomatic. In 3 recurrences developed.

The author feels that cobalt-60 teletherapy may frequently be indicated in complicated or so-called surgical peptic ulcers, particularly in bad-risk patients.

Two figures. GARTH R. DREWRY, M.D.
Tampa, Fla.

Rotational Cobalt 60 Teletherapy of Vesical Cancer. Harry H. Browne and Ralph T. Ogden. Am. J. Roentgenol. **83:** 107–115, January 1960. (Hartford Hospital, Hartford, Conn.)

This is a review of the treatment of carcinoma of the urinary bladder with Co^{60} over a three-year period, with a comparison of the results with cobalt and surgery. The carcinomas were staged according to their spread. Stages A and B were localized to the bladder, with only local muscle invasion; in Stage C there was involvement of the perivesicular fat and/or prostatic urethra, and in Stage D of the lymph nodes of the pelvis. Stage E comprised the inoperable, widespread cases and those with distant metastases. The degree of spread increased with poor differentiation of the tumor.

The authors cite a series of 300 cases reported by Marshall (New York State J. Med. **48:** 875, 1948) in which orthovoltage therapy resulted in a 17 per cent five-year survival with only 6 per cent cures. Complications of this form of treatment are cystitis, contracted bladder, rectal bleeding, and skin changes.

For the present cobalt-60 series the rotational technic was used, with elimination of the rectal segment in a few cases. The focal tumor distance was 75 cm. The portals were either 10 × 10 or 10 × 15 cm. at tumor depth, and the dose was 200 r a day to a total of approximately 6,000 r. A few cases received less, and several more.

Fifty-five cases were treated by cobalt 60 (3 patients with advanced disease died during treatment and are not included). There were alive at the time of the report all 10 patients with tumors of Stages A and B, 62 per cent of those with Stage C and 17 per cent of those with Stage D lesions, and 14 per cent of those who had been classified as inoperable.

Only 5 patients in the series received cobalt therapy alone. The other 50 had either been considered inoperable on exploration or residual tumor was present after definitive operative procedures. Of the 36 cases comprising the latter group, 18 received cobalt therapy immediately postoperatively, with 50 per cent survivals; in the late postoperative group, also numbering 18, there were 28 per cent survivals.

In a concurrent surgical series of 45 patients the survival rate for 39 Stage A and B cases was 75 per cent. There were no other survivals (1 Stage C, 2 Stage D, 3 inoperable).

Significant complications occurred in only 9 per cent of the cobalt-treated series—either severe diarrhea or severe hemorrhagic cystitis. The 2 patients who suffered severe bowel disturbance had received doses of

radiation greater than the usual 6,000 r to the tumor area in a period of six weeks. Two of the 3 patients with urinary tract complications had had prior radon seed implantation.

Eight figures; 7 tables. PAUL MASSIK, M.D.
Quincy, Mass.

Carcinoma of the Uterine Cervix: Interstitial Radioactive Colloidal Gold Therapy of the Lateral Pelvic Nodes. William S. Baker, Jr. California Med. **92:** 25–30, January 1960. (U. S. Naval Hospital, San Diego 34, Calif.)

The author reports a small group of cases of cervical carcinoma (a total of 48) treated with radium and radioactive gold without a long enough follow-up to justify any conclusions. Discussion of these cases is of interest and the review of work of others is worth noting. The physical properties of radioactive gold are said to make this isotope particularly suitable for intracavity and interstitial application. The author quotes these from Veldhuis *et al.* (Surg., Gynec. & Obst. **103:** 539, 1956. Abst. in Radiology **69:** 473, 1957):

1. Colloid with red color.
2. Colloid particles are basically inert.
3. Particle size of 5.0 millimicrons (average).
4. Particles are eagerly ingested by macrophages.
5. Particles deposit rapidly and uniformly on serosal surfaces.
6. Half-life of 2.7 days. Ninety-four per cent of radiation dose is delivered in eleven days.
7. Ninety-five per cent of the tissue ionization produced originates with beta radiation. Radiation consists of three beta and three gamma rays. The 0.290 Mev of gamma and 0.963 Mev of beta make up about 99 per cent of the decay scheme.
8. The maximum range of the 0.963 Mev of beta radiation is 3.8 mm. in tissue.
9. The associated gamma ray serves as a convenient means of identification as well as affording some therapeutic benefit.
10. It can be shipped in convenient glass bottles for assurance of sterility.

Nine tables. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

A 10 Curie Strontium 90 Beta-Ray Therapy Unit. J. L. Haybittle. Brit. J. Radiol. **33:** 52–54, January 1960. (Addenbrooke's Hospital, Cambridge, England)

The advantages of beta applicators, where applicable, are well known. In the past, however, they have suffered from certain disadvantages. The use of the standard applicators, *e.g.*, strontium-90 plaques, was restricted to small areas, while the sheets of radioactive phosphorus-impregnated polythene suitable to larger areas had the disadvantage of impermanence (half-life 14.3 days). In the latter case, in addition, the half-value depth of the radiation was not always adequate.

This paper describes a multicurie strontium-90 source for the treatment of large areas at a reasonable dose rate. The source, mounted on a rotating wheel, consists of about 10 curies of strontium 90, covering an area 6 × 6.8 cm. Bremsstrahlung results in an average dose rate of 35 mr/hr. at the surface of the protective head. There are four applicators—5 × 5 and 15 × 10 cm. at 18 cm. S.S.D. and 30 × 15 and 40 × 20 cm. at 40 cm. S.S.D. The walls are of brass lined with Perspex to reduce scattered beta rays. The largest field requires a filter of polythene to flatten the isodose lines.

Five figures; 1 table. LUCILLE DU SAULT
The Henry Ford Hospital

Quantitative Determination of Gastrointestinal Bleeding Using Cr^{51}-Labeled Red Blood Cells. G. Izak, Y. Stein, and A. Karshai. Am. J. Digest. Dis. **5:** 24–31, January 1960. (Hadassah-University Hospital, Jerusalem, Israel)

Previous work by others has shown that Cr^{51}-tagged red cells injected intravenously into normal human beings will produce no appreciable stool radioactivity over a period of several days following injection. It is also known that the introduction of chromium-tagged red cells into the stomach of normal individuals will lead to no measurable radioactivity in the blood stream. Consequently, the authors assume that a quantitative measure of blood loss can be obtained by relating radioactivity of stool specimens to that found concurrently in circulating blood for patients with gastrointestinal bleeding who have been injected with known quantities of Cr^{51}-tagged red blood corpuscles.

A series of 23 patients reported in this study included 6 with iron-deficiency anemia of unknown cause, 6 with duodenal ulcer, and 5 with bleeding hemorrhoids. Briefly, the patient's red blood cells were tagged with Cr^{51} in known quantity and stool specimens were collected daily for a period of seven days. By comparing radioactivity in blood samples with aliquot proportion of homogenized stool a calculation could be made to determine total blood loss in the stool per twenty-four hours. Results for each of the 23 patients are presented in extensive tabular form, indicating the amount of bleeding over each twenty-four-hour period, and correlating all of the usual laboratory blood values.

It is demonstrated that blood loss can be reliably shown by this test and a reasonable estimation of the daily loss arrived at. It is stressed that the blood loss must occur *during* the period of the examination to be detected. The test seems of special importance in patients with iron-deficiency anemia in whom no organic disease is detectable by other available clinical or laboratory methods.

The authors mention a prominent lack of correlation between the presence of occult blood in the stool as indicated by the benzidine test and the amount demonstrated by the Cr^{51} technic. A possible explanation is the missing of the blood specimen by random sampling of the stool in benzidine testing. It is also noted that a considerable quantity of blood (up to 110 c.c. in a twenty-four-hour specimen) may be present in the stool without frank melena. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Transmission of P^{32}-Labeled Candida Albicans to Newborn Mice at Birth. Philip J. Kozinn, Claire L. Taschdjian, James J. Burchall, and Harry Wiener. J. Dis. Child. **99:** 31–34, January 1960. (Maimonides Hospital, Brooklyn, N. Y.)

Candida albicans was recovered from the mouth and/or gastrointestinal tract of 39 out of 57 newborn mice, representing 9 litters, after vaginal infection of the mothers prior to parturition. The experiments are taken as an indication that human neonatal candidiasis

may be transmitted in a similar manner from mother to child through the birth canal.

A strain of *C. albicans* labeled with P^{32} was used to infect the pregnant mice. Radioactivity could be demonstrated by means of a gas-flow counter in 5, and by autoradiographs in 8, of the cultures recovered from the 9 litters.

It is suggested that labeling with radioactive elements may be a useful tool in tracing the passage of infectious microorganisms from host to host.

Two tables. AUTHORS' SUMMARY

Studies of Regional Lung Function Using Radioactive Oxygen. N. A. Dyson, P. Hugh-Jones, G. R. Newbery, J. D. Sinclair, and J. B. West. Brit. M. J. **1:** 231–238, Jan. 23, 1960. (Hammersmith Hospital, London, England)

The use of a radioactive isotope of oxygen provides a method of assessing regional variations of ventilation and blood flow in the lungs without intubation. For practical purposes this procedure is limited to those having a cyclotron or larger linear accelerator available, since the O^{15} utilized has a half-life of only two minutes. In essence the patient takes a single breath of air containing a trace of O^{15}, then holds his breath while two pairs of opposing scintillation counters placed over the volume of lung under study and a control area record the radioactivity. Coincidence counting has been found to be more reliable in assessing ventilation in small volumes of lung while parallel counting is preferable in assessing blood flow. The clearance rates thus obtained gave important physiologic information in various disease processes, such as pneumoconiosis, bullous disease, idiopathic fibrosis, emphysema, etc.

Approximately 30 patients have been studied and good correlative data obtained. The results are reproducible partly due to the virtually physiologic conditions under which they are obtained. The method has the limitation of studying a columnar volume of tissue rather than a lobe or segment.

Seven roentgenograms; 1 photograph; 10 graphs and charts; 1 table. G. MELVIN STEVENS, M.D.
Palo Alto, Calif.

The Employment of Scanning in the Accurate Localization of Spinal Cord Tumors. F. M. Lyass and B. I. Smagin. Med. radiol., Moscow **5:** 51–52, January 1960. (In Russian)

The topical diagnosis of spinal cord tumors can be established by isotope myelography. Radon or xenon^{133} with an activity of 5–15 μc is mixed with 2 c.c. of air and injected low in the spinal canal. Where there is a subarachnoid block resulting from spinal cord tumor, the air bubble can be caused to rise to the level of the block by proper positioning. The focus of elevated activity is tentatively found with a Geiger counter, after which a scintiscanner is used for more precise localization.

One roentgenogram. FRANK A. RIEBEL, M.D.
Columbus, Ohio

Clinical Value of Liver Photoscanning. Donald A. Fee and Sylvia O. Fedoruk. New England J. Med. **262:** 123–125, Jan. 21, 1960. (Saskatoon Cancer Clinic, Saskatoon, Saskatchewan, Canada)

A Reed-Curtis scintiscanner in use in the authors' department for thyroid scanning was easily adapted so that photoscanning of the liver, as well as conventional data recording, could be obtained. The signal from the scanning probe is fed to a single-channel pulse-height analyzer that passes only pulses due to the 364-kev/I^{131} photopeak. The signal is then fed to the scaler-thyratron-stamper combination used in thyroid scanning or to the ratemeter-recorder-light source combination (as described by Bender) to obtain a liver scan. The scintillation probe consists of a 6292 Dumont photomultiplier tube and a sodium iodide crystal 5 cm. in diameter and 5 cm. thick. The liver scan columnator consists of a solid lead plug with an aperture 7.6 cm. long and 1.3 cm. in diameter. The radioactive dye (rose bengal) is administered intravenously twenty minutes before scanning. The activity used is 2.5 to 3.0 μc per kilogram of body weight. In cases of jaundice in which concentration of the dye in the liver is poor, or in which the liver is believed to be very large, the administered dose of the radioactive dye is doubled.

Experience with this technic in 250 patients suggests that it is of great value in the differential diagnosis of upper abdominal masses and in demonstrating liver metastasis.

Five photoscans; 1 photograph.
MAJ. MARTIN A. THOMAS, M.C.
Lackland AFB, Texas

The Effects of One Curie of Sulfur 35 Administered Intravenously as Sulfate to a Man with Advanced Chondrosarcoma. J. Robert Andrews, Richard L. Swarm, Lawrence Schlachter, Kirkland C. Brace, Philip Rubin, Delbert M. Bergenstal, Hazel Gump, Sidney Siegel, and Robert W. Swain. Am. J. Roentgenol. **83:** 123–134, January 1960. (National Institutes of Health, Bethesda 14, Md.)

The authors report their attempt to inhibit growth of cartilaginous tissue with S^{35} in a 42-year-old white man with an inoperable, well differentiated chondrosarcoma of the right lumbosacral region. The patient had undergone three operations at the site: in March 1953; in January 1954 at which time 4,000 r of medium-voltage x-rays had also been administered; in October 1954. In August 1956 hypophysectomy had been performed, followed by administration of hormones. When transferred to the Radiation Therapy Service of the Radiation Branch of the National Cancer Institute in April 1957, the patient had fecal and urinary incontinence, anesthesia of the right leg, and hypesthesia of the left leg. In the right lumbar paravertebral space, beside the scars from earlier surgery, there were four subcutaneous chondrosarcomatous nodules, one of which was necrotic and ulcerated.

After tracer doses of S^{35} with determinations of the rate of urinary excretion, blood levels, tumor concentration, and skin concentration, the patient received intravenously 1 curie of S^{35} in three increments in a period of twenty-four days. The following month it was found necessary to give blood transfusions and antibiotics. Symptomatic improvement and relief from pain followed.

Before the administration of S^{35} there had been continuous growth of the subcutaneous nodules of the chondrosarcoma; afterward growth ceased for a period of five months, and the ulcerated surfaces of the tumor healed. At the end of May 1958 the nodules began to increase in size again, and at the time of death, Dec. 1, 1958, the tumor had reached massive proportions, with

extensive zones of necrosis. No metastases were discovered at autopsy.

Autoradiographic studies showed persistent radioactivity in scattered areas of necrotic and focally calcified chondrosarcoma. No radioactivity was demonstrated in most of the well differentiated and well preserved chondrosarcoma or in poorly differentiated areas of tumor (apparently recent growth). Radioactivity was demonstrated to a lesser degree, but more uniformly distributed, in rib, joint, and bronchial cartilages.

The authors reach the following conclusions: (1) S^{35} is deposited in relatively high concentration in viable areas of human chondrosarcoma and is retained there for an extended period of time; an intravenously administered dose of 1 curie given in three increments over a period of twenty-four days may effect temporary cessation of tumor growth. (2) The critical tissue for S^{35} appears to be the bone marrow. The dose given to this patient effected a severe depression of hematopoiesis. Marked decrease in the number of circulating platelets was correlated with the presence of S^{35} in the megakaryocytes and in the circulating platelets.

One roentgenogram; 1 autoradiograph; 5 photomicrographs; 3 photographs; 8 graphs; 1 table.

Use of Radioactive Krypton and Cardio-Green Dilution Curves in the Detection of Experimental Portal-Systemic Venous Shunts. Robert T. L. Long, Carlos R. Lombardo, and Eugene Braunwald. Ann. Surg. **151:** 146–152, January 1960. (National Heart Institute, Bethesda, Md.)

Efforts were made to evaluate the usefulness of injections of Kr^{85} and indicator dyes in the detection of experimentally produced portal-systemic venous shunts. Communications between the portal and systemic venous systems were established by the creation of portacaval shunts in 9 mongrel dogs. One microcurie of Kr^{85} dissolved in 1 ml. saline solution, together with approximately 0.60 mg. tricarbocyanine dye (cardiogreen) was injected into the splenic pulp, the portal vein, or into a branch of the superior mesenteric vein. Both indicators were also injected into the femoral vein. Multiple dilution curves were recorded from the expired gas and from blood samples drawn from the right atrium and the femoral artery.

In the presence of a patent portal-systemic venous shunt, the curves obtained resembled those following systemic venous injection; the appearance and peak circulation times were shorter than in the absence of such a shunt.

Preliminary observations in patients indicate that these technics permit detection of the portal venous-systemic venous shunts produced by esophageal varices or surgically created portacaval anastomoses. The detection of patent portacaval shunts in the presence of esophageal varices also appears possible. In clinical practice percutaneous puncture of the spleen and the injection of Kr^{85} dissolved in 1 ml. saline solution through a No. 23- or 25-gauge needle would appear to be preferable to the injection of much larger volumes of radiopaque solutions through larger needles. However, the relative sensitivities of the Kr^{85} and contrast roentgen technics for the detection of varices remain to be demonstrated.

Six figures; 2 tables.

Studies on the Anemia of Tumor-Bearing Animals. IV. Distribution of Radioiron After the Extravascular Injection of Labeled Erythrocytes. Robert E. Greenfield, William R. Sterling, and Vincent E. Price. J. Nat. Cancer Inst. **24:** 87–96, January 1960. (National Cancer Institute, Bethesda, Md.)

Previous studies (J. Nat. Cancer Inst. **21:** 641, 1958. Abst. In Radiology **73:** 492, 1959) showed that certain rat tumors contain large amounts of iron which arise primarily from hemoglobin iron in hemorrhagic areas of the tumor. The present studies attempted to determine to what degree the host is able to reutilize this iron for red-cell synthesis. Because of the complexity of the problem in tumors, initial studies were made on the fate of iron from extravascularly injected cells in normal rats.

When intact erythrocytes which had been labeled with Fe^{59} were injected into the gastrocnemius muscle of normal rats, the radioiron left the site of injection very slowly, at a rate of 1 per cent per day. After sixty days only 18 per cent had been reutilized for the synthesis of new red cells. The rate at which radioiron from labeled cells left the injection site in the leg was only slightly increased in tumor-bearing animals or in animals which had been made anemic by repeated hemorrhage. In contrast, when erythrocytes containing Fe^{59}-labeled hemoglobin were lysed and injected into the gastrocnemius muscle of normal rats, 55 per cent of the radioiron had left the injection site within twenty-four hours and 35 per cent was recovered in the liver. In later experiments, a slow rate was noted when intact cells labeled with Fe^{59} were injected into the tumor tissue of tumor-bearing animals and into the subcutaneous tissue of normal animals. The slow reutilization of iron from injected blood, in these experiments, suggests that the iron from extravasated blood may also be only slowly reutilized in normal and tumor-bearing rats.

Four graphs; 1 table. AUTHORS' ABSTRACT

RADIATION EFFECTS

Sarcoma Following Radiation Injury of Skull. Antolin Raventos, Sidney W. Gross, and Eugene P. Pendergrass. Am. J. Roentgenol. **83:** 145–148, January 1960. (3400 Spruce St., Philadelphia 4, Penna.)

This paper reports a single case of sarcoma arising in the frontal bone or the soft tissues adjacent to it. The patient had been treated at the age of twenty-seven for a presumed pituitary adenoma. A total of 5,560 r was delivered to the pituitary and probably about 2,300 r was directed toward the area where the sarcoma subsequently developed. Roentgenograms taken ten years following the initial x-ray treatment showed multiple areas of bone destruction in the calvaria, most prominent in the left frontal bone. These were considered to represent radiation necrosis, and no further x-ray therapy was given. Seven years later, a tender swelling appeared in the left frontal region. Roentgenograms showed a large defect in the frontal bone. Biopsy of the mass in this area was reported as showing fibrosarcoma. The patient died a year later.

The microscopic examination revealed no evidence of radiation necrosis at the treatment site, and it is suggested that osteolytic areas seen on the roentgenograms might represent bone resorption without actual necrosis.

No record was found of any other case in which a malignant tumor developed in an osteolytic area following x-ray irradiation.

Four roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

The Effects of Radiation on the Lungs in the Treatment of Carcinoma of the Bronchus. Thomas J. Deeley. Clin. Radiol. (J. Fac. Radiologists) **11**: 33–39, January 1960. (M. R. C. Radiotherapeutic Research Unit, Hammersmith Hospital, London, England)

This is a description of the radiologic, physiologic, and pathologic changes which occurred in the lungs of patients receiving 8-mev x-ray therapy for carcinoma of the bronchus. Tumor doses ranged from 3,600 to 4,500 rads in four weeks. The study includes 61 patients who survived more than a year from the beginning of treatment. The courses of 27 patients who survived at least one year after intensive treatment with 240-kv x-rays are also reviewed.

Reactions in the two treatment groups were essentially the same. Dense fibrosis developed at the treatment site. This fibrosis and that of normal lung tissue in the field of treatment led to loss of lung volume and respiratory reserve. All patients surviving fifteen months showed x-ray evidence of lung shrinkage. This developed in the first six months after treatment, and it was irreversible. Pathologically the findings were not specific for radiation damage.

The need for prompt antibiotic therapy in the presence of infection to minimize further fibrosis is stressed.

Five roentgenograms; 3 photomicrographs; 1 diagram; 5 graphs. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radiation Nephritis: Review, Case Report and Animal Study. Bryan L. Redd, Jr. Am. J. Roentgenol. **83**: 88–106, January 1960. (School of Medicine, Emory University, Atlanta, Ga.)

This article is a combination of a review of the literature and a presentation of the results of a limited experimental study designed to determine the effect on the kidney of radiation of various qualities.

The experimental animals were divided into four study groups: those receiving 4,000 r tissue dose to both kidneys (1) with roentgen rays generated at 250 kv, half-value layer 2.7 mm. Cu and (2) with gamma rays from a telecobalt therapy unit, and those receiving 5,000 r tissue dose to the left kidney only by each quality of radiation.

A review of the literature describes the changes observed by the numerous authors who have irradiated the kidneys, both experimentally and clinically. In all animals in the present study which were treated bilaterally uremia occurred, with elevated blood urea nitrogen. This developed faster and was more severe in the animals treated with x-rays. In none of the unilaterally treated animals was hypertension or uremia observed.

Gross pathological findings following irradiation were as follows: In *two to ten weeks* there were no gross changes. In *eight to nine months* the kidneys were shrunken, the cortices were thin, and yellowish deposits were present beneath the surface. These changes were more marked in the animals treated with 5,000 r. No changes were detected other than compensatory hypertrophy in the untreated kidney.

Microscopic changes observed in animals sacrificed at six to nine months consisted of scattered areas of dense interstitial fibrosis with atrophic tubules and hyalinization and obliteration of the glomeruli. The blood vessel walls were thickened and hyalinized. The nonirradiated kidneys showed no changes.

A number of cases of nephritis have been reported in patients receiving various types of x-ray therapy, and a further example is presented here.

In irradiation of the upper abdomen, the field arrangement should be such as to preserve as much of the renal tissue as possible. If irradiation of both kidneys is unavoidable, protective screening should be employed after delivery of 2,000 r tissue dose to the kidneys.

Seven figures. PAUL MASSIK, M.D.
Quincy, Mass.

Study on the Effect of Radiation on the Haemopoietic System in Patients Suffering from Malignant Diseases. Byomkes Basu, Harisadhan Datta, and Haraprosad Chaudhury. J. Indian M. A. **34**: 1–6, Jan. 1, 1960. (Chittaranjan Seva Sadan and Cancer Hospital, Calcutta, India)

The authors studied the effect of radiation on the hemopoietic system in 50 patients suffering from malignant tumors: of the head and neck (37 cases), of the thorax (5 cases), and of the pelvis (8 cases). In 40 patients deep roentgen therapy was used from a 200 to 250-kv machine with a h.v.l. varying between 1.5 and 1.75 mm. Cu; in 10 a million-volt machine was employed with a h.v.l. of 10 mm. Cu. The amount of radiation varied from 0.329 to 19.94 megagram roentgens.

In the majority of patients there was no change in either the hemoglobin level or the erythrocyte count during irradiation. If there was a decrease in either hemoglobin or red cells, it was of minor degree.

In general, the effect of radiation on the leukocytes was to produce a reduction in number. Different types of leukocytes were not equally affected. Lymphopenia was the most prominent finding. Next in order were changes in the neutrophils and eosinophils. Among the 40 cases treated by the 200 to 250-kv machine, the neutrophil count was decreased in 8, slightly increased in 5, and unchanged in 27; 31 patients had a moderate decrease in lymphocytes, 1 had an increase, and there was no change in 8; eosinophils were decreased in 14 cases, increased in 9, and there was no change in 17. Three of the 10 patients irradiated by the million-volt machine showed a decrease in neutrophil count; there was no change in 5, and a slight increase in 2; the lymphocyte count was decreased in 8 patients and unchanged in 2. There was distinct reduction of the lymphocyte count during the period of irradiation.

Eighty-four per cent of the patients with neoplasms in the pelvic area and 75 per cent of those with tumors in the head and neck region showed lymphopenia when exposed to the 200 to 250-kv machine. Irradiation of the head and neck region by the million-volt machine led to lymphopenia in 60 per cent of the cases.

Six tables.

Total Thoracic Irradiation Combined with Intravenous Injection of Autogenous Marrow. K. A. Newton. Clin. Radiol. (J. Fac. Radiologists) **11:** 14–21, January 1960. (Westminster Hospital, London, England)

Seven patients with widespread pulmonary metastases were treated by irradiation of the entire thorax. Irradiation of such very large volumes was facilitated by the injection of fresh marrow from unirradiated areas, thus achieving recellularity of the marrow spaces emptied by the damaging effects of the radiation. Treatment was given with the 2-million-volt Van de Graaff generator, for doses up to 3,000 r in two weeks.

Five patients showed complete radiographic clearance of the metastatic disease after treatment, but in 2 it was uncontrolled. In 5 of the patients repopulation of the marrow spaces was believed to be achieved. Radiation pneumonitis developed and led to the death of 3 patients; in 2 complete clearing of the disease was accomplished without radiation pneumonitis.

The author suggests that in treatment of the thorax, radiation pneumonitis can be avoided by keeping the daily dose below 150 r and the total dose below 2,500 r. The suggestion is also made that if hematopoietic depression can be overcome by repopulation of marrow spaces, it should be feasible to treat even larger areas through the thorax.

Twelve illustrations, including 7 roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Marrow Transplantation After Radiation: An Experimental Approach to the Immunological Complications. K. A. Porter. Clin. Radiol. (J. Fac. Radiologists) **11:** 22–32, January 1960. (St. Mary's Hospital Medical School, London, W. 2, England)

Death from infection or hemorrhage after large whole-body doses of radiation may be prevented by intravenous administration of normal bone marrow. The injected cells act as a graft to promote recolonization of the depleted marrow spaces. The recovered individual is often called a "chimera."

If host and donor are genetically the same (isologous) recovery is lasting. If host and donor are of the same species but different genus (homologous), initial recovery is good but usually temporary, and there is a high late mortality. Where host and donor are of different species survival is brief. The delayed mortality of homologous and heterologous radiation chimeras is called "secondary disease," and it was to study the mechanism and immunological implication of this phenomenon that the present work was carried out.

Young rabbits were treated with total-body irradiation and then were given injections of bone-marrow suspension, lymph-node suspension, or fetal or neonatal liver suspensions.

It was found that if homologous lymph-node cells were added to bone-marrow injections, "secondary disease" was increased and accelerated. It was concluded that, upon proliferation, the injected lymphoid tissues developed an immune reaction against the host antigen. It was also found that secondary disease was reduced and attenuated by giving homologous fetal myeloid tissue (newborn rabbit liver). This was thought to be due to the maturing fetal cells acquiring partial tolerance to the host antigens. However, the suppression was not absolute, and delayed secondary disease developed in a few animals.

Secondary disease has already been reported in human radiation chimeras. How serious a complication this will be is not yet known.

Thirteen photomicrographs; 1 photograph; 3 graphs. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Irradiated Blood-Typing Serum. Robert M. Jamison. J.A.M.A. **172:** 334, Jan. 23, 1960. (University of Missouri Medical Center, Columbia, Mo.)

Comparison of wet and dry typing serums irradiated at a dose level of 10,000 r with fresh nonirradiated typing serum failed to reveal any change in the specificity of blood typing at the dose levels tested. Wet and dry typing serum irradiated to a total dose of 10,000 r in air, when compared with fresh, nonirradiated typing serum, showed no detectable alteration in the specificity of reaction. No delay was observed in the typing reaction. There did appear, however, to be a slight acceleration in the rate of reaction of the Rh group with both wet and dry serums when the typing serums were exposed to 3,000 r.

Effect of X-Irradiation on Hepatic Carbohydrate Enzymes in Control and Hypophysectomized Rats. George Weber and Antonio Cantero. Am. J. Physiol. **197:** 1284–1290, December 1959. (Montreal Cancer Institute, Montreal, P.Q., Canada)

The sequence of metabolic events was investigated in rats for eight days after exposure to 600 r total-body x-irradiation. Preirradiation studies showed that in hypophysectomized animals eighteen hours of fasting reduced the activities of enzymes involved in glucose-6-phosphate utilization, indicating that the hypophysis is involved in the physiological maintenance of these enzymatic activities. In control animals, after irradiation fasting blood sugar and liver glycogen increased, reaching a peak at three days and returning to normal range at eight days postirradiation. Hepatic phosphohexoseisomerase and phosphoglucomutase activities indicated the presence of an increased glycogenesis and gluconeogenesis. Liver 6-phosphogluconate dehydrogenase activity increased to almost double the preirradiation value and stayed at this level during the whole postirradiation period. Glucose-6-phosphatase activity was not affected by irradiation. In hypophysectomized animals after irradiation, blood sugar, liver glycogen and most enzymatic activities remained essentially in the preirradiation level, indicating that hypophysectomy abolished the characteristic carbohydrate metabolic response to radiation. The deficient metabolic reaction of hypophysectomized animals was correlated with the increased mortality rate in this group.

Three figures; 3 tables. AUTHORS' ABSTRACT

The Radiation Dose to the Kidney of the Rat from Inhaled Radon. Donald A. Morken. Arch. Indust. Health **20:** 505–509, December 1959. (University of Rochester School of Medicine and Dentistry, Rochester, N. Y.)

The toxic effects of inhaled radon may be considered to result from the combined actions of three distinct radioactive agents. These agents, all of which arise from atmospheric radon and may be distinguished by their ultimate disposition within the animal, are: (1) the active-deposit of radon which is present in the atmosphere, (2) radon, and (3) the active-deposit of

radon which is produced within the animal. [Active-deposit is a term used to designate the group of short-lived disintegration products of radon, namely, RaA, RaB, RaC, and RaC′. Because of their short half-lives, these isotopes are almost always present in atmospheres which contain radon.] At the present time the most suspect of these is the air-borne active-deposit. Inhalation of this deposit results in the deposition of radioactive material in the respiratory tract, one effect of which is presumed to be lung cancer.

Kidney damage is also evident following the inhalation of radon by mice. The renal lesions are similar to those reported following the intravenous injection of the active-deposit of radon in these animals (dose of 5,200 rad) and of polonium in rats (dose of 2,000 rad).

The author has compared the distribution of activity following inhalation of radon with that following injection of the active-deposit in the rat. Data are tabulated as to the relative activities as follows:

Organ	Relative Activity*		Ratio Active-Deposit/ Radon
	Radon	Active-Deposit	
Kidney	0.27	1.93	7.2
Liver	0.27	0.54	2.0
Spleen	0.27	0.48	1.8
Heart	0.27	0.37	1.4

*Total γ-activity of organ relative to total γ-activity measured from an equal volume of air at equilibrium between radon and active-deposit.

Radon, RaA, and RaC′ are α-emitters; it is assumed that the γ-activities measured in the organs are from an equilibrium mixture of RaA, RaB, RaC, and RaC′.

The equal distribution of radon among the tissues measured and the tissue-air ratios agrees with the findings of others. The active-deposit, however, exhibits a pattern of distribution suggestive of specific physiologic action. The kidney, for example, contains about seven times the γ-activity which can be attributed to its radon content. The RaB or RaC which supplies this excess radioactivity must have been accumulated from the blood.

If the data determined for rats can be correlated with the toxicity and pathology data obtained for mice, the physical dose of α-radiation (about 290 rad) required from radon and its active-deposit to produce extensive renal damage is less than that required from x-rays or Po^{210}. Reasons are advanced for this apparent high effectiveness of the RaA and RaC′ α-particles.

Resistance to Whole-Body X-Irradiation in Rats Made Tolerant to Bacterial Endotoxins. B. W. Zweifach, E. Kivy-Rosenberg, and Arnold L. Nagler. Am. J. Physiol. **197:** 1364–1370, December 1959. (New York University-Bellevue Medical Center, New York, N. Y.)

Rats were treated with three conditioning agents (bacterial endotoxins, zymosan, and compound 48/80) known to produce tolerance to other forms of stress, as a means of determining the importance of the reticuloendothelial system in the response to whole-body x-irradiation (700 to 800 r). Effective protection was provided by tolerance induced by lipopolysaccharide extracts of *E. coli* bacteria. Some protection was also afforded by conditioning with 48/80 for several days. These agents were active only when administered before x-ray exposure. Treatment after irradiation broke down the induced resistance. Blood platelet levels remained high in conditioned animals exposed to irradiation. It is suggested that a relationship exists between the priming or conditioning of the reticuloendothelial system and the maintenance of satisfactory blood platelet levels in adapted animals receiving whole-body irradiation.

Five figures; 1 table.

Pathologic Effects of Thermal Neutrons and the B^{10} (n, Alpha) Li^7 Reaction on Skin. S. W. Lippincott, J. S. Robertson, V. P. Bond, E. P. Cronkite, O. D. Easterday, and L. E. Farr. Arch. Path. **68:** 639–650, December 1959. (Medical Department, Brookhaven National Laboratory, Upton, N. Y.)

The investigation described here was undertaken as part of a series on the effects in tissue of uncharged and charged particles of both low and high energy. The pig was selected for the experiments because its skin, utilized as the tissue of reference, is histologically similar to that of man. Seven animals were irradiated with thermal neutrons for a dose of approximately 5×10^{12} n/sq. cm. and all of these received boron 10 intravenously for doses ranging from 25 to 45 mg./kg. One animal received boron but no neutron irradiation and 2 served as untreated controls. The times of killing the animals following irradiation exposure were fifteen, twenty-four, twenty-five, and one hundred and twelve days.

The B^{10} (n,α) Li^7 reaction was followed by pathologic alterations, characterized by areas of atrophy and of epidermal and dermal necrosis. In 1 pig, a minute squamous-cell carcinoma was observed in the ear twenty-two days after exposure. When the animal was killed on the one hundred and twelfth day, there was a deep ulcer with a heavy granulation base, exhibiting vascular changes, such as excessive capillary formation and bizarre endothelial-cell proliferation.

In a single pig injected with boron only, and in 3 in which the region over the right shoulder was irradiated by neutrons only, no histopathological lesions were present in the skin at the time of killing, after fifteen to one hundred and twelve days. The microscopic appearance of the skin in these pigs was similar to that of 2 control animals.

Ten figures, 2 in color; 1 table.

Radiation Facts for Public Health Officers. Reynold F. Brown. California Med. **92:** 16–20, January 1960. (University of California Medical Center, San Francisco 22, Calif.)

Included in this article are philosophies and factual background which would be useful to the nonradiologist dealing with radiation hazards and their implications. The contribution of the various examinations is put in proper perspective; while the incidence of some diagnostic procedures is low, their contribution to the genetic hazard is great. The figure of 23 per cent for the performance of pelvimetry in primiparae seems inordinately high but is quoted from the literature, which is normally pessimistic. The relative position of fall-out contamination is properly assayed in one of the charts. The radiologist would be wise to review this article if he is to talk to any public health group, as its perspective is good and the details are accurate.

Two charts; 3 tables. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.